FEBRUARY 1959 / 50c

AIR FORCE

The Magazine of Aerospace Power / Published by the Air Force Association

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BRED FOR BRAWN . . .

THE KAMAN HUSKIE

This gas turbine powered helicopter has the stamina and brawn of its namesake, the Arctic Husky. An all-purpose aircraft, the Huskie in the role of the U. S. Air Force base rescue helicopter is ready to spring into action instantly. It's designed to be handled with mittens . . . not kid gloves.

Packing large cargo space within a compact frame, the Huskie is ready to support missile sites or carry troops, supplies and equipment with equal reliability. A direct descendant of the service-tested Kaman HOK and HUK, the H-43B Huskie proves its heritage.

PIONEERS IN TURBINE POWERED HELICOPTERS

THE KAMAN AIRCRAFT CORPORATION • BLOOMFIELD, CONNECTICUT

NUCLEAR DIVISION • ALBUQUERQUE, NEW MEXICO

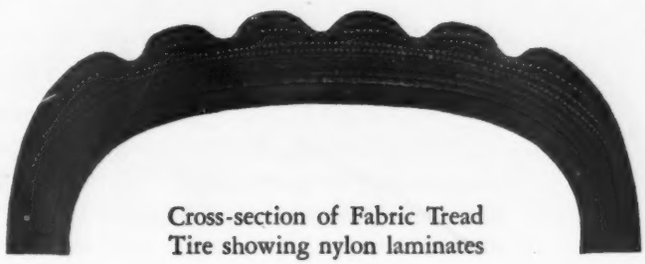
B. F. Goodrich Fabric Tread Tires picked for the X-15

Up, up — 100 miles up at fantastic speeds — the North American X-15 will carry man to the fringe of Earth's atmosphere. And when the X-15 lands it will land at a speed that will demand top tire performance.

That's why B.F.Goodrich Fabric Tread Tires have been selected for the nose wheels of the X-15. Already in service on our fastest jet fighters and missiles, these revolutionary B. F. Goodrich tires outperform all previous jet tires.

Nylon laminates built into tread stock reduce rubber distortion under load, equalize modulus between tread and carcass, check formation of "shock wave". Unique Fabric Tread designs eliminate stress points found in ordinary high-speed tires, also resist tread cutting and punctures.

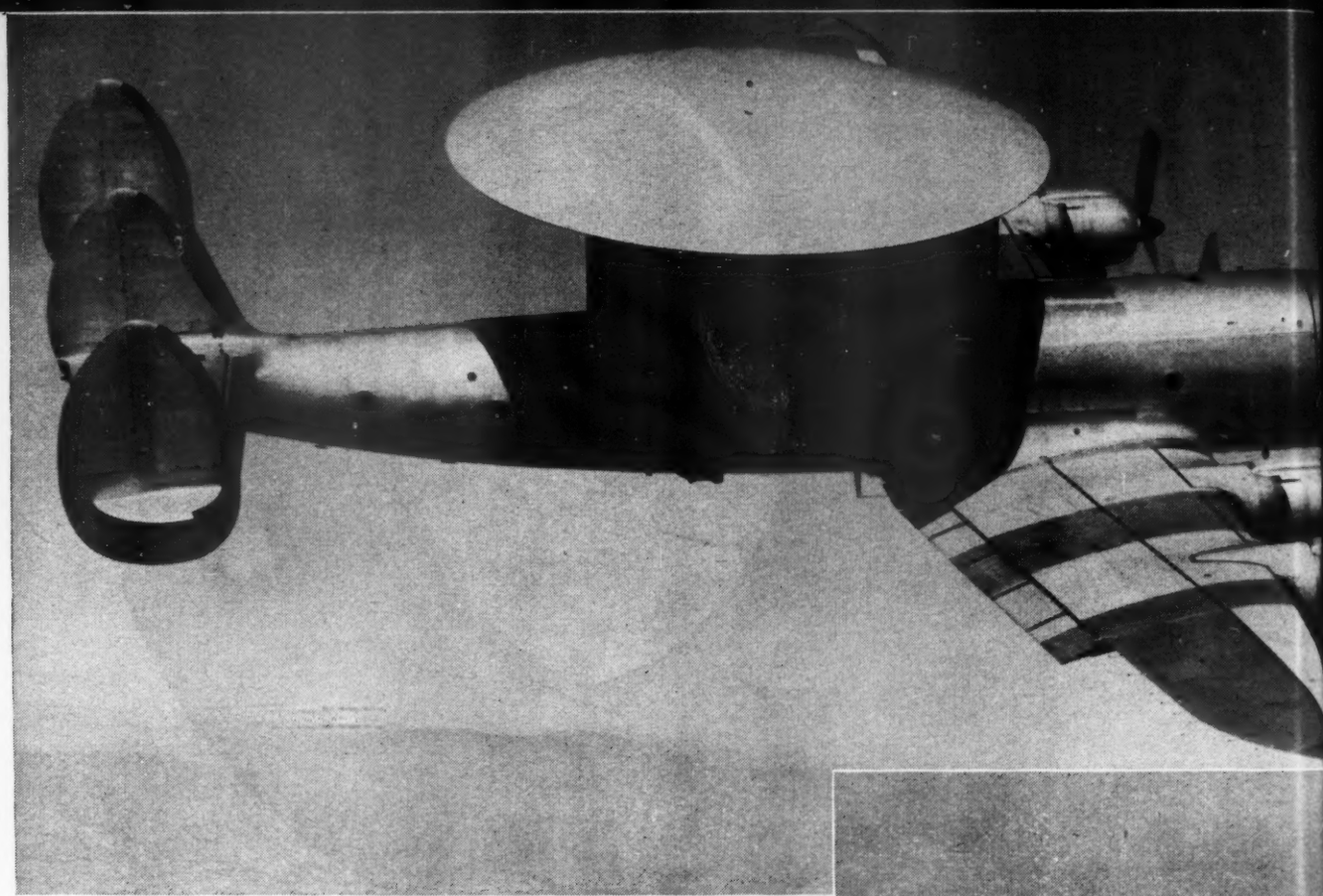
Without a doubt, B.F.Goodrich Fabric Tread Tires mean safer takeoffs, more landings, for your supersonic aircraft. Find out more about Fabric Tread right now by contacting *B.F.Goodrich Aviation Products, a division of The B.F.Goodrich Company, Dept. AF-29, Akron, Ohio.*



Cross-section of Fabric Tread Tire showing nylon laminates

B.F.Goodrich ***aviation products***

Lockheed's flying saucers...America's best pro



U. S. Air Force RC-121D (above) is one of the 229 AEW&C Constellation-series aircraft produced in past decade by Lockheed. Hundreds of U. S. Navy P2V anti-submarine radar patrol aircraft have also been produced by Lockheed.

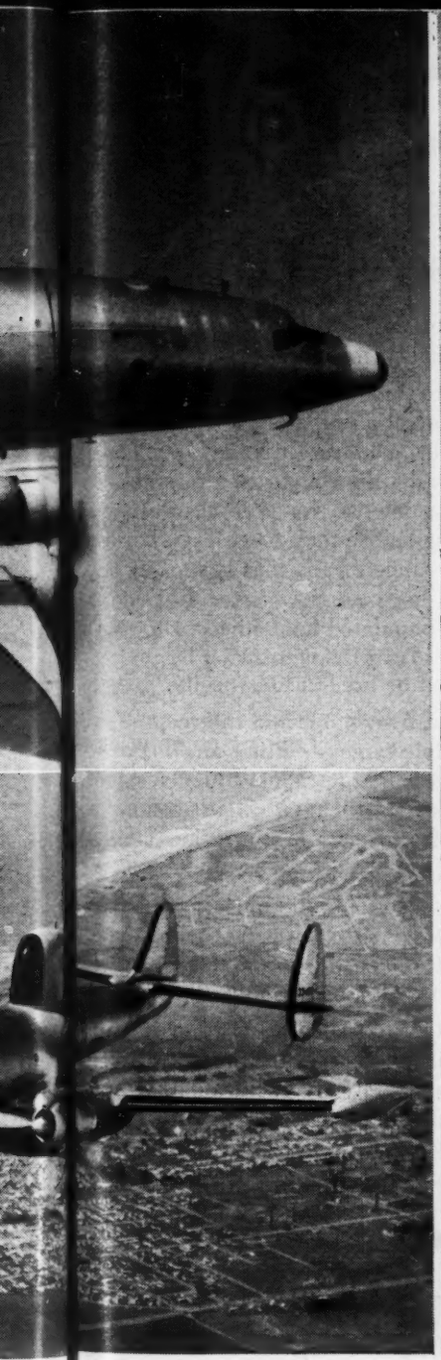
Night and day, in all kinds of weather, Lockheed AIRBORNE EARLY-WARNING & CONTROL planes of the U. S. Air Force and Navy patrol our outermost defense perimeters.

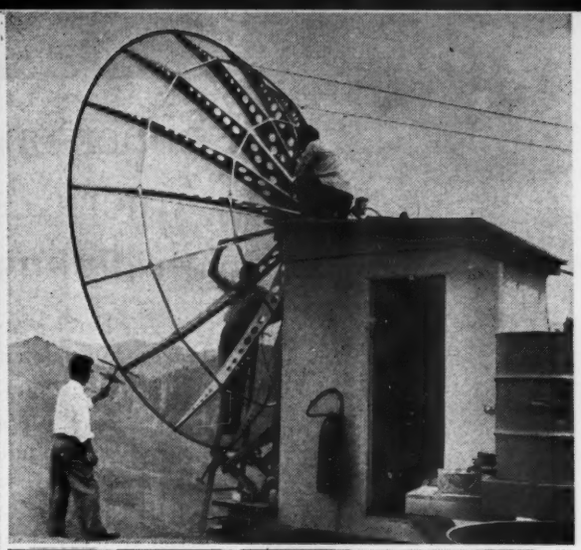
Every 10 seconds these far-ranging sky sentinels (photo, right) can radar-scan an area bigger than the state of Pennsylvania—detecting surface ships and aircraft even in complete darkness or thickest fog. But, due to swift technological progress in long-range missiles and supersonic aircraft with nuclear weapons, there was a foreseeable need for AEW&C planes with even greater capabilities—and the huge "flying saucer" radome was developed.

For the past two years this Lockheed "flying saucer"—installed atop a U. S. Navy WV-2E — has undergone extensive flight testing. Its exact range and capabilities must remain a military secret, but this much can be revealed: when America needs a better AEW&C System this Lockheed-developed "flying saucer" will contribute importantly to the fulfillment of that vital need.

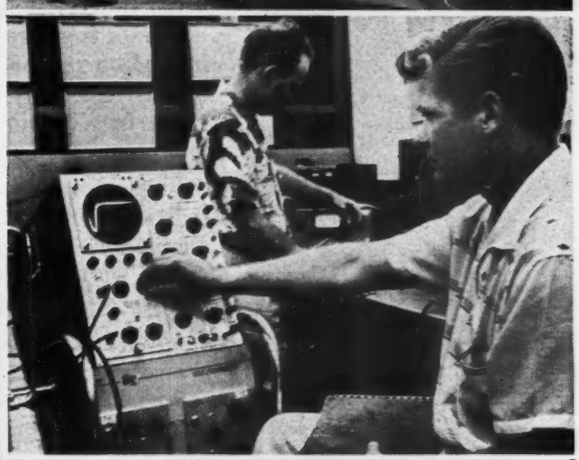
Lockheed's 10-year experience in the design, manufacture, and maintenance of operational AEW&C planes is greater than that of all other aircraft and electronic manufacturers combined.

est protection against future sneak attack





Lockheed, the only airframe manufacturer to have its own radar antenna ranges, has *five*. Intensive research and development of better airframes, antennas, radomes, and equipment for AEW planes is an unceasing effort at Lockheed.



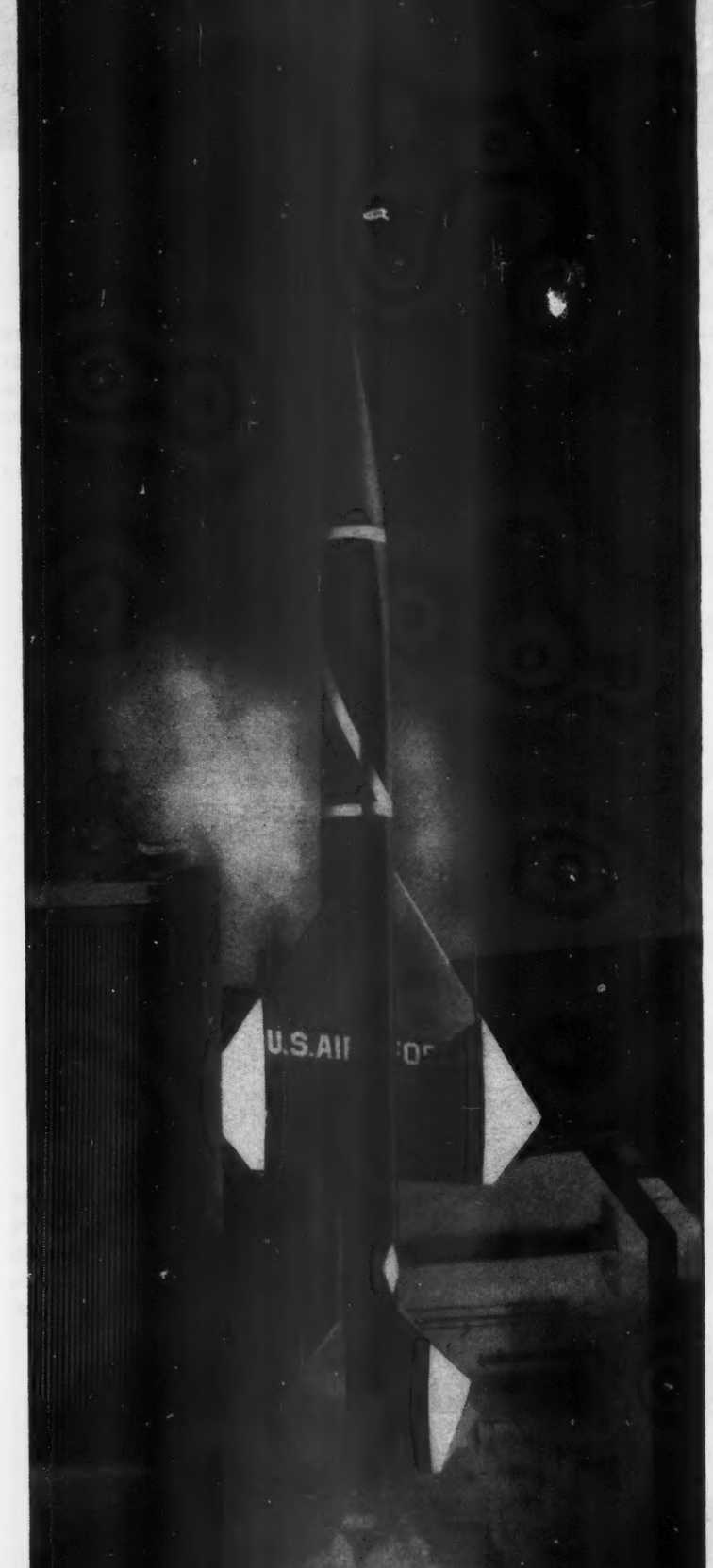
Lockheed's California Division —with over 50,000,000 manhours of Airborne Early Warning & Control experience—has the industry's finest team of electronic engineers, technicians and assembly workers.

Some 221 field service men represent Lockheed away from the factory, including 73 electronics service specialists. At the factory, 36 airframe and electronic instructors serve Lockheed's many customers.

LOCKHEED

OCKHEED AIRCRAFT CORPORATION, CALIFORNIA DIVISION

T FIGHTERS • JET TRAINERS • LUXURY AIRLINERS • PROP-JET TRANSPORTS
RBORNE EARLY-WARNING AIRCRAFT • ANTI-SUBMARINE PATROL PLANES



Supersonic BOMARC, America's longest-range air-defense missile

The Air Force's BOMARC is the most advanced, longest-range defense missile in the nation's arsenal.

Its range—200 to 250 miles—enables a single BOMARC base to protect an area of more than 200,000 square miles. One result is far fewer bases than would be required by short-range missiles. Another is effective defense, for BOMARCs destroy aerial attackers long before they reach U.S. borders. BOMARC's superior range means that bases can be located on remote, low-cost sites, instead of on expensive densely-populated land adjacent to major cities. In addition, it can be maintained by minimum crews and be fired automatically.

Single BOMARCs can seek out and intercept individual or multiple targets—either aircraft or missiles. They can be fired in rapid-sequence salvos. Armed with a nuclear warhead, a single BOMARC can destroy an entire formation of attackers.

BOMARC has great growth potential. Its range is being extended to more than 400 miles, which will enable one BOMARC base to protect more than 500,000 square miles. BOMARC can be developed to cope with intercontinental ballistic missiles.

The BOMARC system has been proved out in exhaustive tests, and the first base—at Eglin Air Force Base, Florida—is already operational. Other bases are nearing completion. BOMARC, in addition, has been chosen by the Canadian Government as its principal air-defense weapon.

BOEING BOMARC

AIR FORCE

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An Editorial

The Limp Is Becoming a Hobble

John F. Loosbrock, Editor

EXAMINING the Air Force budget year after year, as we do, and comparing it with the task it is called on to perform (which can only be based on a similar examination of Soviet capabilities) leads one to wonder what has happened to the old-fashioned commodity called horse sense. Anyone who has tried to keep a growing family in shoes can imagine what would happen if you bought the same size year after year for a growing boy. He could still get about year after year, perhaps, but as the shoe pinched more and more the limp would become a hobble.

Yet that is about what is happening to the Air Force, and to the other military services as well. The job gets bigger, but the means to accomplish it remains about the same. At least that is the conclusion gained after spending a couple of hours listening to the Pentagon's fiscal experts brief the Washington press corps on the eve of the President's budget message.

For fiscal year 1960 (July 1, 1959 to June 30, 1960) Congress is being asked to provide the Department of Defense with $40.85 billion in new obligational authority, as against $41.138 billion for fiscal year 1959. Expenditures for the same period are estimated at $40.945 billion, compared with an estimated $40.8 billion for the current (1959) fiscal year.

The Air Force's share of the pot would break down as follows:

USAF BUDGET SUMMARY—FISCAL 1960

Title	New Obligational Authority (in billions)		Expenditures (in billions)
OPERATING COSTS			
Military Personnel	$4.066		$4.058
(Active Forces	$3.964)	($3.959)	
(Reserve Forces	.102)	(.099)	
Operation and Maintenance	4.426		4.349
TOTAL OPERATING COSTS	$8.492		$8.407
CAPITAL COSTS			
Procurement	$8.175		$8.224
(Aircraft	$4.409)	($4.362)	
(Missiles	2.601)	(2.768)	
(Other	1.165)	(1.094)	
Research, Development, Test and Evaluation	1.150		1.011
Military Construction	.915		1.058
(Active Forces	$ .894)	($1.041)	
(Reserve Forces	.021)	(.017)	
TOTAL CAPITAL COSTS	$10.240		$10.293
REVOLVING AND MANAGEMENT FUNDS	(none)		(less $ .025)
TOTAL OPERATING AND CAPITAL COSTS	$18.732		$18.675
AVAILABLE BY TRANSFER	(less $ .050)		
TOTAL NEW OBLIGATIONAL AUTHORITY	$18.682		

Broken down among the services, new obligational authority and expenditures estimates look like this:

SERVICE	NEW OBLIGATIONAL AUTHORITY	EXPENDITURES
Army	$ 9.357 billion	$ 9.264 billion
Navy	11.370 billion	11.596 billion
Air Force	18.682 billion	18.675 billion

In addition the Office of the Secretary of Defense is asking for $1.441 billion in new money, including $455 million for ARPA, with expenditures expected to run $1.410 billion.

We will examine USAF figures in terms of force levels and specific programs in a subsequent issue, as the testimony develops on Capitol Hill. For the moment we will content ourselves with a few words of caution as to trends and definitions.

First, those who have followed the budget in past years will notice that the categories of appropriation and expenditure have been shuffled about a bit. This is most notable in the area of research and development, where certain items, not spelled out, which formerly were carried under procurement and other categories have now been transferred to research and development and the name of the category has been lengthened to "Research, Development, Test and Evaluation."

Second, the trend toward level budgets in terms of both new obligational authority and expenditures is confirmed by the figures for fiscal year 1960. This is probably the most discouraging aspect of all to planners who are looking ahead to the years of the missile gap. The cost of weapon systems is rising steadily, and the really expensive ones have yet to go into big production. To be sure, expenditures in certain areas dip a bit, as Pentagon spokesmen pointed out, when missiles like Thor and Jupiter reach the end of the procurement cycle and other systems like Rascal and Goose fall by the wayside. But these programs are relatively inexpensive compared to those still in the development end of the cycle, such as Titan and Minuteman. And there is nothing in the trend of new obligational authority to indicate that there will ever be money to pay for such systems and other new ones coming along, in operationally safe quantities.

Meanwhile, Congress is in a rebellious mood and the budget figures are going to get a thorough working over on the Hill. Complaints have already been voiced that the Administration is not spending the money voted by Congress last year for defense, to the tune of some $700 million. In discussing this point, a Pentagon spokesman said this unspent sum covered several items including tankers for SAC, strategic airlift, Polaris, and Regulus missiles, and other items. Asked about the $90 million voted to speed up the Minuteman program, the Pentagon budget expert said it was actually being spent, not out of what Congress has voted, but "from another pocket." Which led one newsman to grumble, "That guy's got more pockets than Houdini's overcoat."

But a look at the expenditure columns over the past years indicates that the people's elected representatives will have a hard job thrusting their will down the Administration's throat. Congress can vote more new obligational authority than the Administration requests and ticket it for whatever programs it wishes. But new obligational authority is merely a license to spend, with no weight of command.

You can issue a hunting license to a hunter but you can't make him shoot.—END

OPERATION DEEP-FREEZE

THE IROQUOIS GOES INTO THE CLIMATIC HANGAR AT EGLIN FIELD

Before the Army puts its final stamp of approval on the Iroquois, it is being run through the toughest obstacle course ever devised for a helicopter. But the Bell HU-1A turbine-powered helicopter was designed and built to meet the Army's exacting standards of performance and maintenance . . now it is proving it.

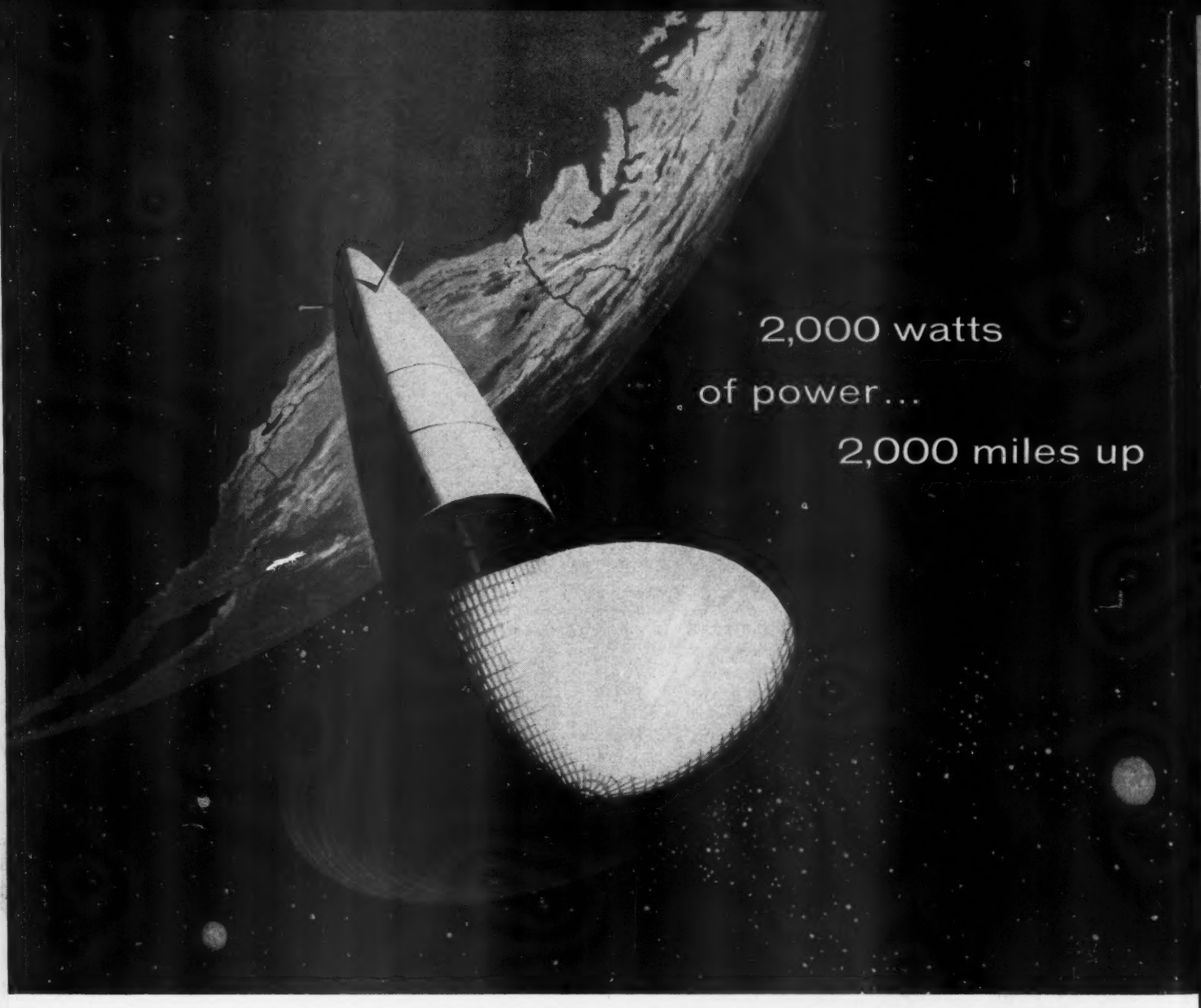
One of the hard-fisted Army tests for the Iroquois was the cold chamber test conducted at Eglin Air Force Base and completed successfully on schedule. Here it went into the climatic hangar and its performance was checked under simulated operating conditions . . in the deep freeze of –65°F. Now the Iroquois has gone to Canada and Alaska for actual Arctic testing.

Operational tests from the arctic to the desert . . performance and stability tests . . tests under simulated battle conditions . . logistic support tests . . the Iroquois is getting "the works" to prove its worth as a front-line vehicle. Proof again that the Army gets what it asks for . . equipment "Above the Best."

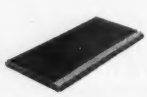
FORT WORTH, TEXAS

SUBSIDIARY OF BELL AIRCRAFT CORPORATION

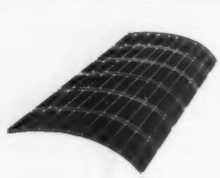
BELL Helicopter CORPORATION



Hoffman solar cells—lasting thousands of years—convert sunlight into electricity to supply power for satellites and space vehicles during entire orbital life.



Highly efficient silicon solar cell converts up to 10% of the light energy striking it into usable electrical power.



Typical solar energy converter. A panel of solar cells of approximately 20 square yards can produce 2,000 watts of electricity.

How much electrical power do you need to run a satellite's transmitter or instrumentation system, or furnish operating power for a manned space station? 5 milliwatts? 2,000 watts? Whatever power you'll need up there—out of reach of conventional energy sources—you'll be able to get... direct from the sun!

Solar energy converters, capable of delivering 2,000 watts or more, are now feasible as power sources for inaccessible and remote places.

Hoffman silicon solar cells, used in these converters, are the most practical and efficient means yet developed for converting solar energy into electricity. Already proved in the U. S. Navy's *Vanguard* satellite, Hoffman solar cells will continue to power its radio transmitter as long as it orbits the earth.

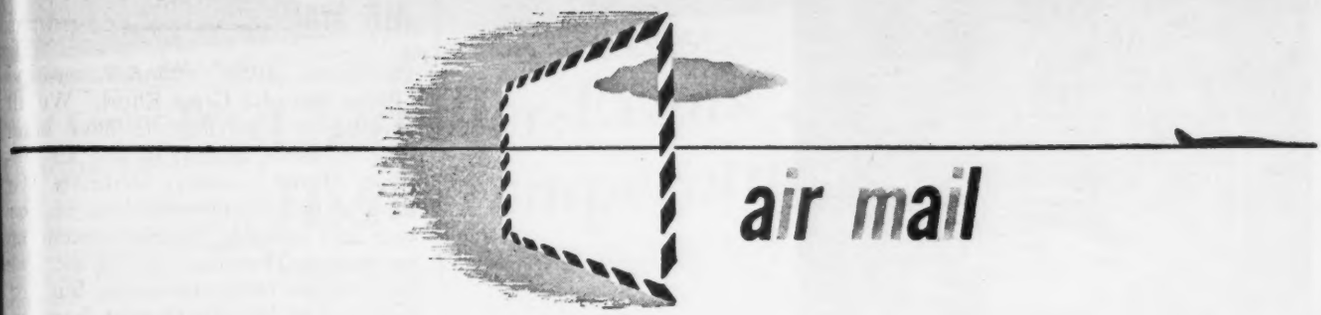
Hoffman Electronics CORPORATION

HOFFMAN LABORATORIES DIVISION / 3740 South Grand Avenue, Los Angeles 7, California

Missile Support Equipment · Radar · Communications · Electronic Countermeasures · Navigation
Semiconductor Applications · Electro-Mechanical Equipment · Weapons Systems

For more information, write Dept. 10, Hoffman Laboratories.

Silicon solar cells—by Hoffman—the key to today's and tomorrow's problem of power in outer space.



Difference of Opinion

Gentlemen: I have just returned from Russia where I traveled 9,100 miles while studying the Russian school system in completing requirements for my doctor's degree at Boston University.

My 8,000 miles of travel on the TU-104 did not bear out your statement of November, page 20, that the TU-104 "barely struggles off the runway at Moscow." This Russian jet carries two engines with a dry thrust of 19,000 pounds each—and the passenger load is a minor matter compared to the weight it was designed to carry. I was told by the pilot of one of the jets that 1,900 meters were required for takeoff—but in each case we used less than this, were fully loaded, and had plenty of push—no sluggishness.

I'm not anxious to extol the virtues of the TU-104, which has many shortcomings when compared with the Boeing 707, in which I've flown close to 4,000 miles. However, to attempt to describe the TU-104 as underpowered and inadequate functionally is a gross misstatement. This kind of complacency and underestimation could be extremely dangerous. I hope your sources of information in more critical areas are more accurate.

Millard Harmon
Auburndale, Mass.

● *Guess it just depends on where you're sitting.* AIR FORCE's *observations are based on first-hand experience of a passenger who has also ridden in the TU-104 as well as the French Caravel transport and the Boeing 707. Compared with these two aircraft, he says, the TU-104 definitely is sluggish, and in terms of its payload required a long ground run before takeoff. Much of this run is made with the nose high and the wings at a very high angle of attack, indicating a critical takeoff factor. On the occasions* AIR FORCE's *observer has ridden the TU-104 (also out of Moscow), practically none of the paved runway was left when the plane left the ground. Nineteen hundred meters (6,233 feet) is not a short takeoff distance for a jet airplane with no more payload or range than the TU-104. As for the thrust of the AM-3 engines in the TU-104, the Russians themselves announced at Zurich in 1956 that they were rated at 14,800 pounds static thrust at sea level. In the air museum in Moscow, where the engine is displayed, the guides tell visitors that the engine is rated at about "7,000 kilograms," or approximately 15,400 pounds static thrust. The TU-104A is in the same performance category. The Russians have recently come up with the TU-104B model* (see page 15).—THE EDITORS

Jet Age Airports

Gentlemen: The article "Airports and the Jet Age," by Claude Witze, in the December 1958 issue of AIR FORCE is an excellent summary of the bond and federal aid financing problems faced by civil airport operators.

It is a story which I am sure will give a better understanding of our common financial problems to AIR FORCE readers, and I hope that such veterans as FAA Administrator E. R. Quesada and Pentagon officials with responsibilities for defense ground installations will have occasion to read it.

E. Thos. Burnard
Executive Director
Airport Operators Council
Washington, D. C.

Inevitable Technical Revolution

Gentlemen: I must commend AIR FORCE Magazine on their new SPACE DIGEST section. It is very interesting and informative. . . .

I am writing this as a disgusted aircraft worker. Since the so-called recession began last year, the aircraft industry has dealt most of us a terrific blow. With the advent of missiles and jets, all the industry has done is cut the assemblers and other production workers out of their jobs. All we hear is that new projects are under development and that when they are ready for production we will get our jobs back. But it never materializes. Not as many production workers are needed to produce missiles, but there must be other jobs.

I have studied aircraft and aviation since I was old enough to read, have done two tours in the Air Force, and lastly have worked as a production worker in the aircraft industry. Aircraft and aviation is all I know. . . . Presently I'm studying aeronautical engineering, but it will be at least two years before I'm an engineer. What can I do in the meantime? Are we to be left out in the cold and away from the work we love? . . .

Walter L. Mock, Jr.
Los Angeles, Calif.

● *Reader Mock's problem is shared by thousands caught in the technological revolution now under way in the aircraft industry. Much as we deplore the budgetary neglect now damaging the force in being, we do not believe that money alone can halt the revolution or change the character of new weapons in the next few years.* —THE EDITORS

Mutual Respect

Gentlemen: I have read with the greatest satisfaction your editorial concerning inactivation of the Ground Observer Corps in the December edition of AIR FORCE Magazine.

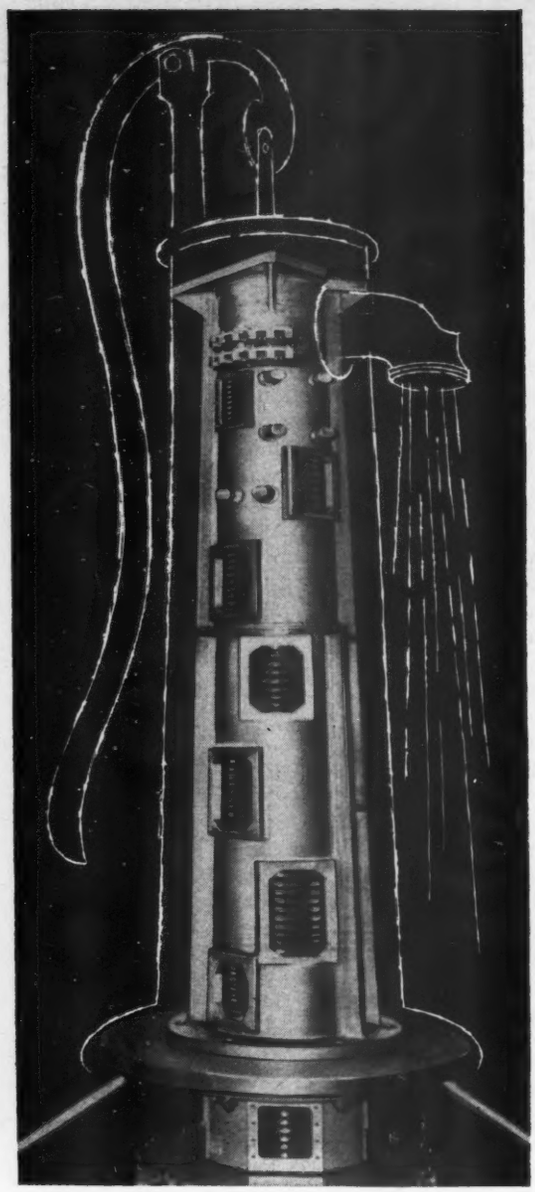
As is the case in all things you select for coverage, your piece on the GOC has just the right touch. Your comparison with the B-36—its coming into and going out of the nation's airpower inventory without ever striking a blow—is as apt as it is accurate. We do feel that the GOC has played its part in deterring air attack upon this country.

I wish to thank you, both for myself and on behalf of the entire Air Defense Command, for your most excellent and considerate treatment of this subject. I feel that the piece will, indeed, contribute to a continuation of the "mutual feeling of interest and devotion" that has grown up between the Air Force and the volunteers—and this is what we want above all.

Lt. Col. Charles R. Stapp
Chief, GOC Div., ADC
Ent AFB, Colo.

Gentlemen: I would like to thank you for your great tribute to the members of the Ground Observer Corps in the

(Continued on following page)



Slip Rings Aren't Supposed To Pump Water!

But prefabricated slip ring assemblies generally do! Spaces and voids, inherent in stacking or encapsulation of components, create natural "atmospheric pumps" which literally suck and trap moisture from the outside air into the voids, causing inter-ring leakage and lower insulation resistance.

Crosstalk is phenomenally low in Electro Tec slip rings because there are no spaces and voids between rings. The one piece plastic blank is fully cured and precisely machined to exact size before the fine silver or 24K gold rings are electrolytically deposited.

Slip rings manufactured by Electro Tec's unique process* guarantee inter-ring resistance to be greater than 10,000 megohms† at 500 volts, at 95% relative humidity, values far above the minima called for in applicable MIL SPECS. In addition, they offer higher mechanical strength and stability under the severest conditions of temperature, shock and vibration, due to unitized symmetrical construction.

Another of the outstanding features of Electro Tec slip rings is the unique molecular bond between ring and lead wire, only possible in electrodeposited assemblies. Slip rings of fine silver, or 24K gold, consistently give lowest electrical noise and longest life.

†This minimum guaranteed figure is a function of design. Some designs are being manufactured with over 200,000 megohms at 500 volts at 95% relative humidity.

*Pat. No. 2,696,570 and other patents pending.

Write Electro Tec Corporation on all your slip ring applications.

ELECTRO TEC CORP. *Products of Precision Craftsmanship*

P. O. Box 37N, SOUTH HACKENSACK, N. J.

AIR MAIL——CONTINUED

December 1958 editorial entitled "Phase Out of a Great Effort." We all consider it a privilege to have been able to serve as part of the air defense of our country. Certainly we have a better understanding of the vast and complex defense system of our nation. Therefore, we do not feel that we are being discarded, but are delighted to be able to relax because we know we are giving way to a better and more accurate system which has been developed to cope with today's speeds and new air defense weapon systems.

We will, as Group of Civilians, strive to continue to keep abreast of national defense developments and our deepest interest and backing will be for airpower.

Mrs. Margaret Heldt, Chairman
California GOC Assembly
Pacific Grove, Calif.

Of Value to OCS

Gentlemen: The Officer Candidate School wishes to thank AIR FORCE Magazine for the excellent article "So You're at OCS Now . . .," by Louis Alexander, which appeared in December 1958. Its timely appearance should serve to increase interest by highly qualified airmen to submit applications for this training.

The article contains information of much value to assist us in the orientation of each incoming class. We would greatly appreciate receiving 250 reprint copies to use in our program.

The staff and faculty of Officer Candidate School make extensive use of material appearing in AIR FORCE Magazine, both for personnel career orientation and in presentation of curriculum to the Officer Candidates.

Col. M. C. Barnard, Commander
OCS
Lackland AFB, Tex.

● *Thanks for your interest. We have no reprint copies of the article but gladly extend reprint permission.* —THE EDITORS

For Young and Old

Gentlemen: Have several reasons for complimenting you on the fine November issue, but I believe the main one is the good use to which my boy, Bill, put the SPACE DIGEST section. He's a high school senior and had a tough assignment to do, a winner-take-all theme on satellites. Went to the library and found plenty on Red satellites but very little on our own, which he was assigned to exploit. Then he spotted your fine issue.

Jay Vessels
Austin, Tex.

CECO NEWS

CHANDLER-EVANS SYSTEMS • CONTROLS WEST HARTFORD, CONNECTICUT

New Center Has Unique Features

The Control Console in CECO's newest test facility incorporates latest state-of-the-art instrumentation and provides for push-button ease of operation. Any malfunction in any part of the system activates both audible and visual alarms. Electrical interlocks automatically shut down the system and indicate the specific area of malfunction.

If the operator does not or cannot take the necessary corrective steps within a predetermined amount of time, required corrections are made automatically and the test is resumed.

Engineered for Safety

While the Test Platform with its Ambient Chambers can easily be seen through a maximum safety window in the forward wall of the Control House, all tests are 100% remotely controlled. Operators set and control temperatures and pressures, and assemble all necessary data at the Control and Instrumentation Console.

The entire CECO Thermo-Research Center has been painstakingly engineered to provide optimum safety, both for operating personnel and for the valuable mechanisms being tested.

So thorough are the safety precautions that despite the hazards inherent in handling fuels at elevated temperature, lowest premium cost fire insurance premiums on this facility are in the category ("Sprinkler Rating").

Described as "Operator-Proof"

A highly complex operator-overriding system, developed especially for this facility, assures proper operation at all times. Operator errors, if and when they occur, are corrected automatically.

Fuel Density Indicator

A meter in the Control House gives continuous indication of fuel density. It gets its signal from the intensity of radiation through a section of the fuel conduit. Isotope Cesium 137 is used in this radiation process.

Chandler-Evans Announces New High-Temperature Test Center

LATEST CECO DEVELOPMENT TOOL: Two structures make up the Chandler-Evans Thermo-Research Center. One (shown above in foreground) is a concrete and steel, insulated and soundproofed Control House.

The second structure (background above) is an "open air" Test Platform, sheltered from the elements by a sheet metal roof containing plastic blow-out sections. Test Chambers and all associated equipment are installed on this platform.

CECO Facility Tests Fuel Devices In Environments To 1000°F.

West Hartford, Conn. (CECO)—Completion of a new and vastly capable Thermo-Research Center has been announced by Sidney A. Stewart, General Manager of Chandler-Evans. The 100% company-owned facility is considered to be unique in the modern aircraft industry. It is designed to subject sensitive fuel mechanisms and other hydraulic devices to elevated temperatures similar to those developed in ultra high-speed flight.

As a development tool, the Center is expected to provide answers to many questions that have perplexed engineers since advanced air speeds first began to create critical high-temperature problems.

Chandler-Evans has been "hot-testing" aircraft engine accessory products for a number of years. Initially, relatively simple facilities were equal to the task. But, as aircraft and missile speeds advanced into Mach ranges, it became apparent that tempera-

(to accommodate 300-hour fuel system tests, for example) can be carried out twenty-four hours a day, seven days a week.

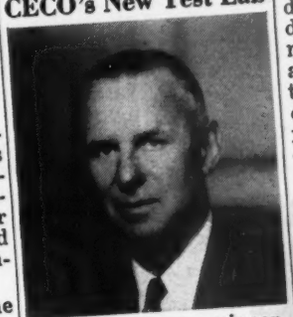
Others to Use Lab

CECO's new Thermo-Research Center has been made available to others, according to Ercole J. Vitali, Manager of the Company's Engineering Test and Experimental Departments.

On a limited basis, the laboratory and its staff will be put at the disposal of manufacturers who are similarly concerned with the functional performance of liquid fuels, fuel system components, and other hydraulic equipment when subjected to the stresses of elevated temperature. Ambient and fuel temperature capabilities currently specified are 1000°F. and 500°F. respectively.

Vitali went on to say that subcontract customers can gain valuable time and save money as well by calling on CECO's

S. A. Stewart Lauds CECO's New Test Lab



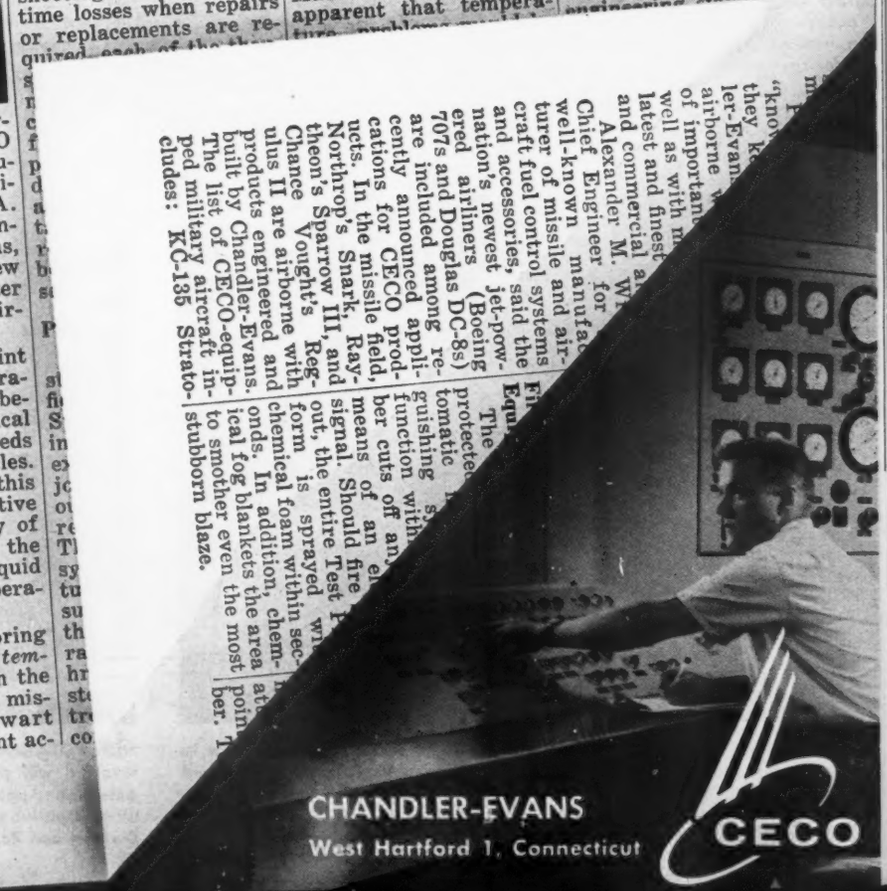
"This unique engineering tool will enable CECO to continue developing superior products empirically," said Sidney A. Stewart, General Manager of Chandler-Evans, when the company's new Thermo-Research Center was unveiled for the aircraft industry.

He went on to point out that high-temperature problems have become increasingly critical with advancing speeds of air and space vehicles. "We expect to find in this new laboratory definitive answers to a variety of questions relative to the precise metering of liquid fuels at high temperatures," he said.

Further underscoring the importance of *temperature extremes* in the modern aircraft and missile industry, Stewart mentioned concurrent activities in the cryogenics field. He said CECO is designing and producing devices for use in liquid nitrogen systems, for example, where temperatures of −330° F. are encountered.

Part Numbering

To simplify trouble-shooting and minimize time losses when repairs or replacements are re-

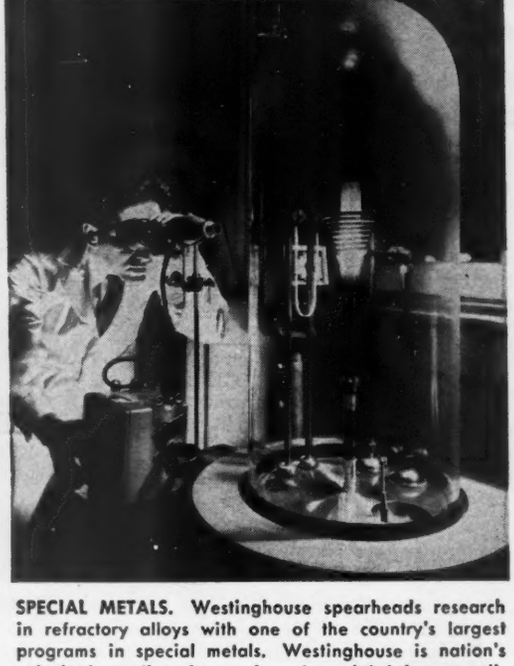


CAPABILITIES FOR DEFENSE

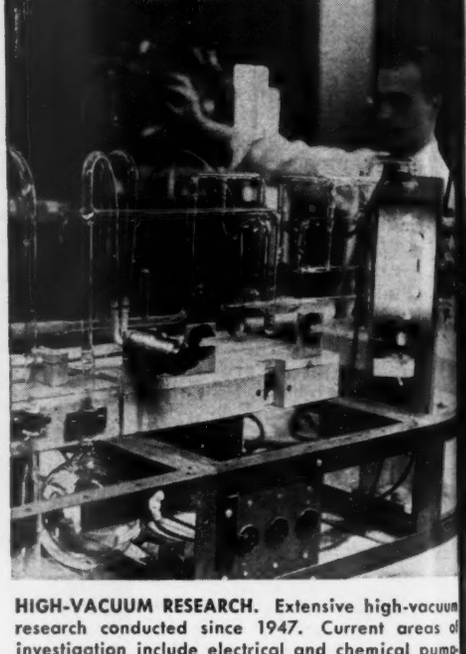
Westinghouse is spending $185 million for research and development in 1959

HERE ARE SOME CURRENT PROJECTS...

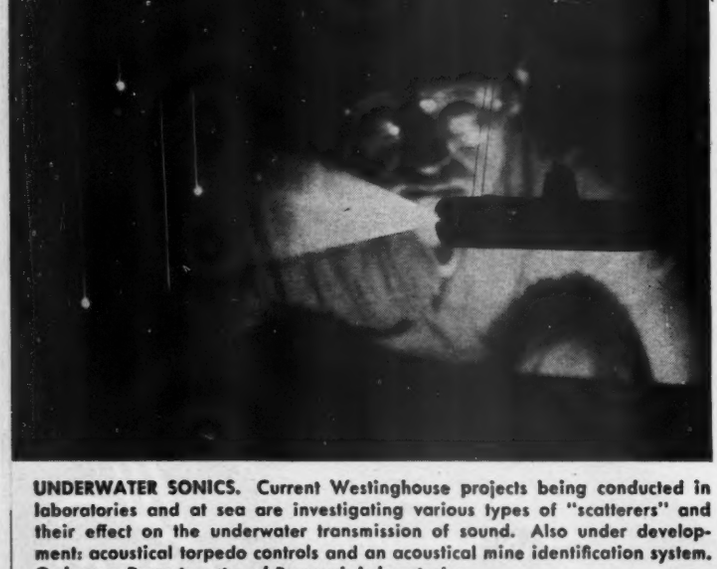
HIGH TEMPERATURE ELECTRICAL INSULATION. Effective for long periods at 500° C—eventual applications to 1000° C now contemplated. Demonstration motor shown above is running red hot. *Aircraft Equipment Department, Materials Engineering Departments, and Research Laboratories*



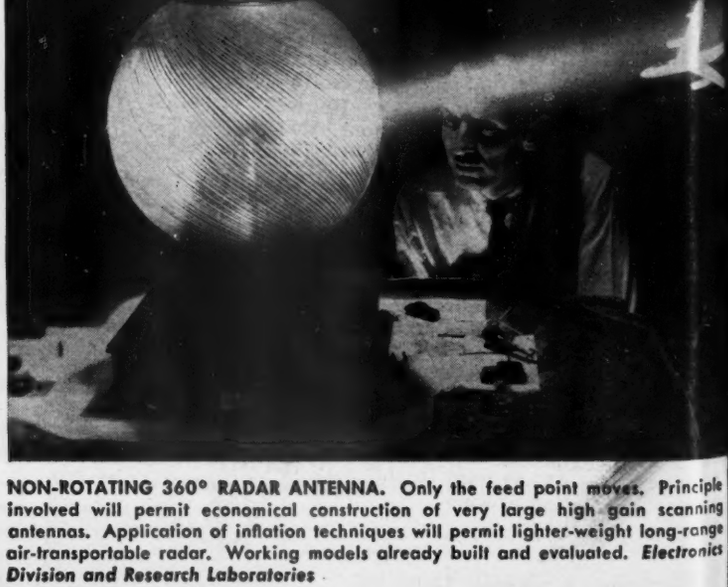
SPECIAL METALS. Westinghouse spearheads research in refractory alloys with one of the country's largest programs in special metals. Westinghouse is nation's principal supplier of a number of special defense-application metals. *Materials Manufacturing Department, Aviation Gas Turbine Division and Lamp Division*



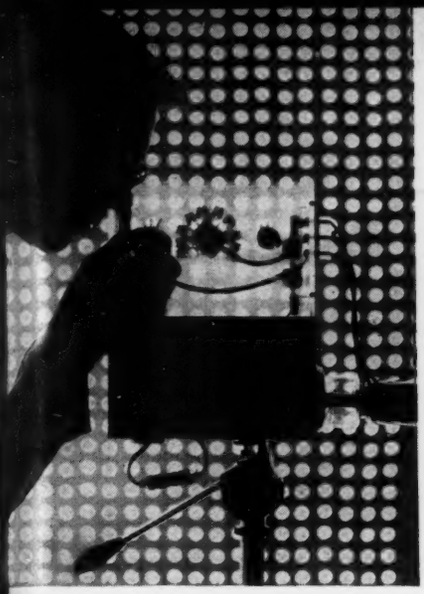
HIGH-VACUUM RESEARCH. Extensive high-vacuum research conducted since 1947. Current areas of investigation include electrical and chemical pumping in ultra high-vacuum range and component development for large high speed pumping systems. Results being applied in advanced electronic device development. *Air Arm Division and Research Laboratories*



UNDERWATER SONICS. Current Westinghouse projects being conducted in laboratories and at sea are investigating various types of "scatterers" and their effect on the underwater transmission of sound. Also under development: acoustical torpedo controls and an acoustical mine identification system. *Ordnance Department and Research Laboratories*



NON-ROTATING 360° RADAR ANTENNA. Only the feed point moves. Principle involved will permit economical construction of very large high gain scanning antennas. Application of inflation techniques will permit lighter-weight long-range air-transportable radar. Working models already built and evaluated. *Electronics Division and Research Laboratories*

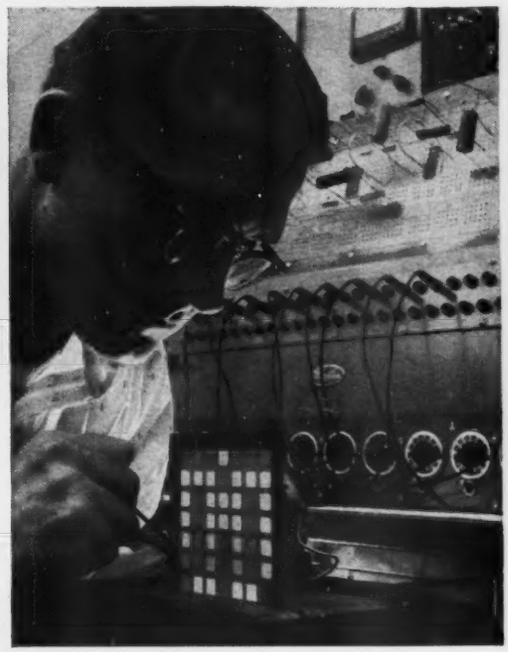


LIGHT AMPLIFICATION, through electron bombardment induced conductivity. Extremely sensitive. Principle especially useful for satellite reconnaissance devices. Efficient working models have been developed. ***Electronic Tube Division, Astronautics Institute and Research Laboratories***

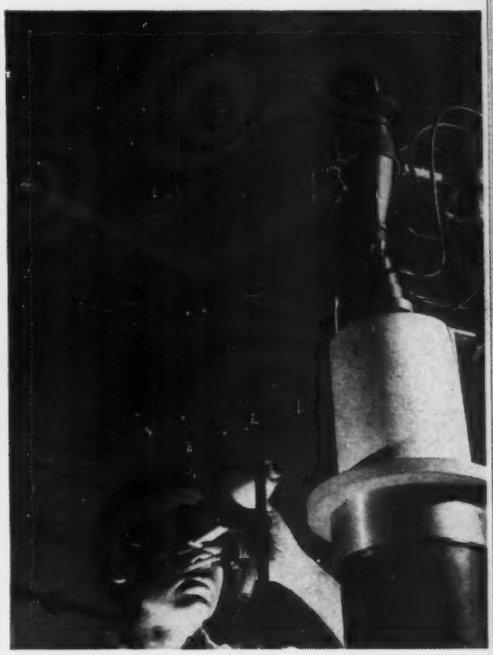
NUCLEAR RESEARCH. At the Westinghouse Testing Reactor, engineers are preparing high intensity radiation tests on a wide range of materials to determine their structural, chemical, and nuclear stability. This is a necessary prelude to using these materials in certain atomic power applications now under development. ***Atomic Power Department***

INFRARED research projects include: *thermal imaging* — working models in advanced development; *ultrasensitive doped crystal detectors* — advanced test models; *photo-electric magnetic detection* — working model. ***Air Arm Division, Semi-Conductor Department, Materials Engineering Departments, and Research Laboratories***

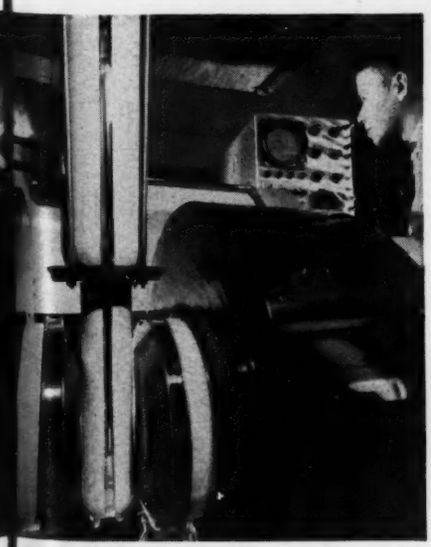
PULSE-DOPPLER RADAR is in advanced development in three major areas of application at Westinghouse. Research is continuing to open up new potentials. Westinghouse is the acknowledged leader in this field. ***Air Arm Division***



NEW DATA DISPLAY DEVICES. Electroluminescent cells, individually controlled, form flat picture. Model has oversize cells for demonstration; latest techniques produce cells only 1/16" across. Similar tote board display, capable of high-speed read-out of digital inputs, in production. Both devices can be erased instantly or retained and studied for long periods. ***Electronics Division, Rayescent Lamp Department and Research Laboratories***



THERMOELECTRICITY. Westinghouse recently developed the first efficient material to produce electricity directly from heat at high temperatures (1100° C). In addition, other thermoelectric material under development can be used for cooling purposes, including very light-weight applications. Forty Westinghouse scientists now on this project. ***Materials Engineering Department and Research Laboratories***



LOW-NOISE MICROWAVE AMPLIFICATION. Westinghouse scientists have developed various low-noise solid-state amplifying devices, both MASER and non-linear reactance types. Progress in recent years was speeded by prior years of research in low-temperature and solid-state physics. ***Air Arm Division and Research***

For information on these and other research projects, write to Mr. E. W. Locke, Director, Customer Relations, Westinghouse Defense Products Group, 1000 Connecticut Avenue, N.W., Washington 6, D. C.

Westinghouse

DEFENSE PRODUCTS

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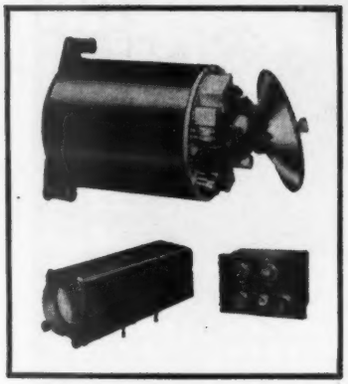
The APS-67 Airborne Radar . . . designed and developed by *The Magnavox Company* in conjunction with the Navy Department, gives eyes that see by both day and night to the Crusader.

The APS-67 delivers the utmost in performance and reliability for this Navy Fighter . . . clearly demonstrating *The Magnavox Company's* ability to produce and work as prime contractor on a complex electronics project.

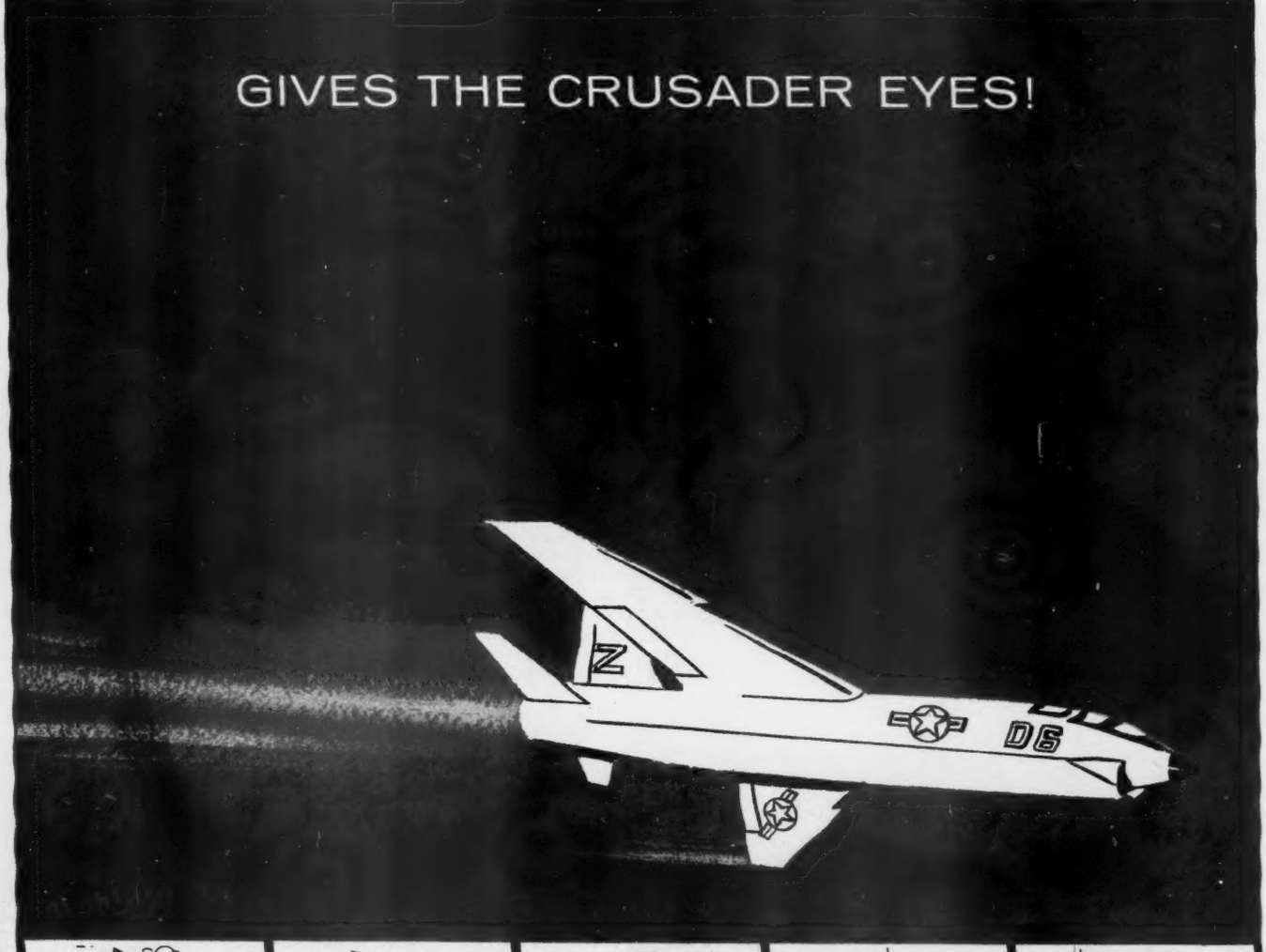
MAGNAVOX capabilities are in The Fields Of Airborne Radar, ASW, Communications, Navigation Equipments, Fusing and Data Handling . . . your inquiries are invited.



PRODUCTS THAT SEE BY THEMSELVES

Magnavox

GIVES THE CRUSADER EYES!



THE MAGNAVOX CO. • DEPT. 39 • *Government and Industrial Division* • FORT WAYNE, IND.

What's New With ★ RED AIRPOWER

Here's a summary of the latest available information on Soviet air intelligence. Because of the nature of this material, we are not able to disclose our sources, nor document the information beyond assurance that the sources are trustworthy.

Look for an expanded Soviet Aviation Day air show this year. In 1957 the show was canceled because of bad weather. Last year it featured little that was new, possibly to avoid any suggestion of saber rattling during the Middle East crisis.

But lately the Russian aviation press has been taking pot shots at the British Farnborough show held a few months ago. It has been critical of the British for not displaying newer, more advanced aircraft and helicopters.

Since the Russians are overdue in showing new aircraft themselves, and are known to have several that have been test flown, more or less secretly, it would appear that they are setting themselves up to outshine the British in 1959. Only a major international crisis is likely to keep them from putting on an elaborate display.

• • •

Russia's atomic-powered airplane probably has still not flown with its history-making propulsion plant. However, it is ready at a Soviet testing field near Moscow. The Reds are making every effort to get it into the air on nuclear power as soon as possible, but so far their haste appears to have made waste.

• • •

Recently released Russian figures show Soviet trade with non-Communist countries went up twenty-four percent from 1956 to 1957. However, trade between the US and USSR in the same period fell about nineteen percent.

The list of products the Russians are trading shows interesting anomalies. They purchased machine tools in Italy, for example, but sold machine tools to India. They bought Egyptian cotton in large quantities, but exported cotton to both France and England. And while Russian bauxite (aluminum) production has been expanding at a great rate in recent years, the ore was imported in quantity from Greece. The data indicates Russia is pushing its trade in an effort to make other countries economically dependent on her.

• • •

First purchase of the IL-18 transport outside of Russia will be by Czechoslovakia. The aircraft will be used on medium-range routes and will go into service this year. This is Russia's second medium-range turboprop transport and it is similar to the Lockheed Electra.

• • •

Ever since Marshal Zhukov was ousted as Russia's top military commander last year, an all-out effort has been under way to strengthen Communist Party discipline in the armed services.

"It should be said that Party criticism of shortcomings has definitely increased in the army, navy, and air forces of late," Col. Gen. Golikov, Director of the Chief Political Administration of the Armed Forces, wrote in *Pravda* some weeks ago. "However, there are still some individual leaders who try to reject criticism or who accept it in word only. These comrades should be reminded once again that in the military, as elsewhere, criticism and self-criticism are constant weapons against lethargy, conceit, and complacency and against shortcomings in work and conduct."

Bad economy of the TU-104 has caused the Russians to come up with another new version, the TU-104B. Also, much larger US jets now in operation have made the Soviet transport look poor by comparison.

The original TU-104 had a seating capacity for fifty passengers in first-class accommodations. TU-104A had the same size cabin, but by going to three-abreast seating and other changes, capacity was increased to seventy passengers. The TU-104A is used on the Moscow-Prague run.

Now the Russians have lengthened the fuselage of the airplane by about four feet and rearranged the interior to crowd in more seats. Payload was increased about 8,000 pounds, according to the Russians' own figures.

However, there remains the question of how well it will perform. The TU-104A was a ground-loving airplane with unspectacular performance. One thing done was to increase greatly the already large flap area on the TU-104 wing (*see cut*). Though they haven't said so, the Reds may also

New TU-104B will have even larger flaps than those shown on this earlier model in a photo made at Prague in 1957.

be using an improved engine that delivers more thrust than the 14,800 pounds in the TU-104's original plant. An even easier way to better the airplane's performance would be to get some of the military-bomber weight out of it. Original TU-104 was some 40,000 pounds heavier than European jet transport designs of equivalent performance, payload, and range.

• • •

The AN-10A, a production version of the four-engine turboprop transport, is expected to be in service soon in the USSR. Noticeable modifications since the first model appeared: small vertical fins on the ends of the horizontal stabilizers and a sizable fin on the underside of the fuselage at the tail. Following the AN-10A will be the AN-16, a larger version that can handle 130 passengers.

• • •

Andrei Tupolev, seventy-year-old dean of Russian aircraft designers, has received the Order of Lenin from the Presidium of the Supreme Soviet "for his contribution to the development of Soviet aviation."—END

AIRPOWER in the news

Claude Witze
SENIOR EDITOR

Is It the Subliminal Technique?

WASHINGTON, D. C.

One of our distinguished daily contemporaries reports that the promoters of subliminal advertising have fallen on hard times. Subliminal projection, in case you haven't been keeping up with Madison Avenue, is a process that is supposed to sell cereal or tooth paste or gasoline or what have you without having the potential customer know he is being hit by an ad. The message is flashed on a movie or TV screen so briefly that it registers only on the subconscious mind. It can also come over the radio, the promoters claim, so softly and quickly that you don't know you heard it.

Well, the business of selling this way is on the rocks, largely because the public won't have any such nonsense imposed on it as a captive audience. The promoters say this is a case of the man in the street just not understanding their techniques and intentions, but there is evidence to the contrary. Maybe the customer understands it too well.

We couldn't help thinking there was somewhat of a subliminal effort being made in the Pentagon on New Year's Eve. That was the day the press corps was summoned to the front office a few hours before the bourbon and branch water began to flow. They were given the two Defense Department Directives you will find starting on page 130. Both of them became effective the first of the year, when the Defense Reorganization Act of 1958 was implemented and the Secretary of Defense assumed full control of the unified and specified commands.

After the documents were distributed, there followed a long press conference with Donald A. Quarles, Deputy Secretary of Defense, in which we detected a subliminal message to the effect that there just isn't any problem about roles and missions of the armed forces and no conflicts. The subliminal message came through loud and clear to the reporters who were on guard against its influence.

Mr. Quarles called the two papers the "Roles and Missions Directive and the Relationships Directive." In a flash he added that the first one does not make any shift in roles and missions as previously delineated, but only realigns them as required by the new command structure. The subliminal message was that there is no intention at this time of doing anything to clarify a badly muddled situation. In other words we are not moving at all in the direction of making some key decisions that threaten to put some military noses out of joint.

The press jumped heavily on the language differences in the outline of functions for the Army and USAF. On our page 132, under Army functions in paragraph 1 (b) of the directive it says the Army will "organize, train, and equip" units for use in the air defense mission. At the top of page 136, under USAF functions in paragraph 1 (g) it says the Air Force has a duty extending to "doctrines, procedures, and equipment" for air defense, with the additional phrase that USAF will "develop" these things.

On top of this, the paper says the Army's air defense duties are to be carried out "in accordance with doctrines established by the Joint Chiefs of Staff," a phrase that is missing from the USAF clause. The pursuit of this oddity by the reporters did not appear to be a case of nitpicking, and finally Mr. Quarles said it is possible there are ambiguities and, later, "there may be a little shading of difference."

He cited the memorandum on "Clarification of Roles and Missions" issued by Defense Secretary Charles E. Wilson in November of 1956. In that document the Army was told not to plan on operating missiles with a range of more than 200 miles but also was given responsibility for the development, procurement, and manning of point-defense missile systems. Mr. Quarles was queried at his New Year's Eve party: Was the Army given responsibility for development of the Nike-Zeus antimissile-missile because it was considered point defense?

Here is his reply:

"I can say this, that by its nature and to a degree antimissile defense is point defense, because the character of the missile, the ballistic missile trajectory, is such that you have to deploy the defense some place in the general area of the target being attacked. . . . However, one can say that is semantics and one does not have to rely on the November 26, 1956, memorandum. The subsequent memorandum dealing with the Zeus authorization to the Army was a supplement to the November 26 memorandum, and the two stand together as equal and must be taken together as policy."

The Deputy Secretary said a few moments later that, while there has been no decision, "it is almost implicit that Nike-Zeus if standardized for deployment would be procured, deployed, and manned by Army components of the Continental Air Defense Command." Four questions later, he said there has been no decision to deploy Zeus and until then there is no way of knowing who will use it in the field.

When he was all through, the subliminal message was quite liminal. It said the bosses will have to steel themselves some day to decide who is going to use an antimissile-missile, just as they will have to decide who has a mission in space.

Let's Look at the Record

Anastas I. Mikoyan, the one-man Soviet goodwill mission, arrived in Washington on the coldest day of the young winter. The thaw followed immediately, running the temperature up in such cities as Detroit, Cleveland, Chicago, west to San Francisco, and back again. No doubt about it, he is the best public relations man we have seen come out of Russia.

We are equally conscious of the fact that more and more Americans are visiting Moscow, and it is a worthy thing. Everybody read with interest the observations of Minnesota's Senator Hubert H. Humphrey in his long call at the Kremlin. This was good, too. What is beginning to worry us a bit is the evident reaction of many US citizens.

The whole thing is more and more reminiscent of the late 1930s with all that talk about how we could do busi-

(Continued on page 19)

Higher

faster

training

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T-37

Cadets in the U. S. Air Force now get a faster introduction to jet flying. Sitting side by side with their instructors, they're quickly learning to handle Cessna's T-37—a new, high-flying trainer with the characteristics of a combat jet. As a result, cadets are trained faster and easier (at substantial savings) to assure America's future in the air. Cessna Aircraft Company, Wichita, Kansas.

Cessna *Inquire today about the rewarding future your Air Force offers you.*

Sperry's new SRU-216 broad band klystron

has 2,000-mc tuning range combined with frequency stability under severe shock and vibration

- **Requires less than 15 watts total power**
- **Non-axial motion of tuning shaft**
- **Low tuning torque**

This new Sperry Klystron features superior electronic characteristics yet is so rugged it can withstand the severe environments encountered in missile and jet radar applications.

The SRU-216 not only has an extremely wide mechanical tuning range of 2,000 mc but also offers a very wide electronic tuning range from 60 to 100 mc. Frequency remains stable even under severe pressure, vibration and shock environments.

PERFORMANCE	
Frequency Range	15.0 to 17.0 kmc
Power Output	15 mw (min.) from 15.0-15.7 kmc
	20 mw (min.) from 15.7-17.0 kmc
Frequency Stability Under	
Vibration	2.0 mc (max.) at 10 g's, 40-500 cps
Low Pressure	−4.0 mc (max.) at 70 mm Hg
Shock	±1.0 mc (max.) at 70 g's for 6.5 ms, 3 axes
Temperature Coefficient	−3 mc/°C

This new tube makes for easier system design. Low power consumption means smaller associated equipment . . . air cooling is not required. Potted base eliminates need for pressurization. Design provides more linear frequency-to-turns ratio over tuning range. The optional four locations of the shaft with respect to waveguide flange gives designers extra flexibility. Write for more information on this new Sperry Klystron.

SPERRY

SPERRY ELECTRONIC TUBE DIVISION, SPERRY RAND CORPORATION, GAINESVILLE, FLORIDA

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ness with Hitler. When these reminiscences needed confirmation and the thermometer was in the forties we strolled over to our neighbors at the Washington bureau of *Life* Magazine. We thumbed through some old issues and made a few notes.

Because human charity is widely shared in editorial offices, our report will omit names. But on page 18 of *Life* for July 24, 1939, there appears this headline: "U.S. Publishers, Who Flew the Atlantic, Return with Assurances of Peace." Sure enough, there are pictures of eight prominent Americans. The editors of *Life*, no tongue in cheek, said these men had spent three days in Europe after crossing on the first flight to go to the continent by way of Newfoundland and Ireland. It was a route they unwittingly blazed for the four-engine bombers.

How did they spend their three days?

"As practical journalists in search of a story," according to *Life*. The subject: "Will there be war?"

Their virtually unanimous opinion: "There will be no war this year."

Here are some of the choice quotes from the lines beneath their pictures:

"There will be no war, but England is ready."

"I came back reassured."

"The situation has greatly eased."

One prominent man said he had sat next to Chamberlain at tea and, "I am less inclined to think there is going to be a war than when I went over."

Another, a man who bossed a major newspaper chain and news service, had no doubt about the enduring peace. He said both Anthony Eden and Lord Beaverbrook had assured him there would be no war.

A final publisher displayed the kind of journalistic skepticism of which great newspapers are made. He said he found a newsman in Europe who predicted there would be war in seven weeks. However, he continued, "my impression is there is very likely not to be a war this year."

Well, there were exactly thirty-eight days between the time that issue of *Life* hit the newsstands and September 1, 1939.

That was the day Hitler marched into Poland.

"Competition" From MATS?

The Military Air Transport Service looks forward to a continued struggle for existence in 1959. It is a bit of an oddity that the advice of the Joint Chiefs of Staff, who determine what MATS should be, is questioned so avidly in this case by some of the very people who make money out of MATS. Some of these people run airlines that get most of their business from MATS contracts. We know of one case where a company drawing eighty-six percent of its profit from this source is fighting tooth and nail to curtail the operation of government-owned planes on the worldwide routes of MATS.

Most recent outbreak, just before the first of the year, came from the US Chamber of Commerce, which is circulating a six-page MATS study. The title describes MATS as a "competitor of private enterprise," neatly avoiding the fact that private enterprise in fiscal 1959 alone will get about $80 million for hauling goods and people overseas. The Chamber says it has made progress in its "struggle" to cut the size of MATS' own fleet and help from local Chambers is needed to continue the struggle this year.

The Chamber says MATS argues that it needs a fleet of operating airplanes to meet national emergencies at a time when it would take too long to enlist the civil aircraft. The Chamber's argument is that the Civil Reserve Air Fleet—the airline equipment—can be ready in forty-eight hours, and it doubts MATS can get its own planes on the job much quicker than that.

Lt. Gen. William H. Tunner, Commander, Military Air Transport Service

Lt. Gen. William H. Tunner, MATS commander and once boss of the Berlin Airlift, has been striking back in recent months with a smart educational effort. He has held a couple of seminars at Scott AFB, Ill., home of MATS, for top executives of the commercial carriers most interested in the MATS program. There were presentations by General Tunner's staff on such subjects as the mission, the industrial fund program, the current commercial contracts, and MATS operations.

It is too bad the Chamber of Commerce was not invited. The facts of life were explained in terms of the problems MATS faces in such areas as aircraft modification, overseas base provisions, and the necessity for planes with long range. Contracts were discussed with emphasis on USAF's determination to favor long-term, fixed-price, fixed-route deals as the best kind of business for the government and the carriers. It was pointed out how introduction of the Industrial Fund System, under which the user pays MATS for its service, has forced finely balanced flying programs with firm financial plans and operating budgets.

Possibly most important, the work done by MATS during the crises in Lebanon and Formosa was described in detail. In the first instance, as previously pointed out on Capitol Hill, secrecy was vital in the first hours of the action when thirty-six C-124 transports were mobilized in Europe for emergency lift of men and supplies to the Eastern Mediterranean. Only MATS could have carried out this job. In the second case, operational deployment of F-104 fighters to Formosa was made possible by MATS, and their appearance is credited with forcing a big change in the program of the Chinese Communists.

The continued effort to make Congress slash MATS and pour more contracts into the commercial chute should result this year in resolution of a basic conflict. The Army is screaming, almost as loudly as the Chamber of Commerce, that USAF, far from having too much airlift in readiness, does not have enough.

It was pointed out in AIR FORCE Magazine last August that MATS is airlift in being, just as the Strategic Air Command is deterrence in being. If anything is needed at this time, it is better equipment. But the decision must be made by the military, rather than by the Chamber of Commerce.

(Continued on following page)

Dr. York Looks Ahead

Dr. Herbert F. York, who was sitting in the Pentagon all through the four-month hunt for a Director of Research and Engineering, has been appointed to the job. There has been no criticism of the choice and none is expected. The selection, in fact, was greeted with something like a sigh of relief from interested parties who were trembling in the face of the terrible alternatives that were visible. It was pointed out in AIR FORCE last month that the longer it took to find the man, the greater the peril that he would be a second-rate one. But Dr. York is no second-rater. He is a first-rate choice, a pure scientist. He moved to his new job from the Advanced Research Projects Agency. He is a member of the President's Science Advisory Committee. He is thirty-seven years old (*see page 91*).

One of the fascinating facets to this appointment is the renewed interest it has aroused over the future of ARPA. Dr. York's induction was followed at once by a press conference at which he was pressed against something that looked like a wall. What, he was asked, would become of the offices of William M. Holaday, Director of Guided Missiles, and ARPA, headed by Roy Johnson?

Dr. York said research and engineering aspects of the guided missile office will be shifted to his office, along with the bulk of the staff. Mr. Holaday already has a new job as chairman of the Civilian-Military Liaison Committee to the National Aeronautics and Space Administration and the Department of Defense. Demise of his old office of Director of Guided Missiles is one of the least-lamented passings in the history of military weapons development.

ARPA, however, remains on the scene and Dr. York said, at least at one point, that it will continue because ARPA or something identical to it must do the job. The job, as he sees it, is to conduct research and development in areas assigned by the Secretary of Defense. The armed forces will continue to do their research and development, too, and everybody will be under the general supervision of Dr. York.

A United Press reporter still was skeptical about ARPA: "If they gave the Nike-Zeus back to the Army and the Sentry program and Discoverer program back to the Air Force and let you supervise them, wouldn't that take care of things?"

Dr. York: "Well, ARPA is not just a name. ARPA is a group of people who are familiar with these programs, have developed a familiarity over the last few—over the last less than one year—and to just arbitrarily make changes would lose all of that, the value of having that particular group work on it."

Mr. Clark: "Aren't you doing that with Foote's [Paul D. Foote, former Assistant Secretary for R&E] office and Holaday's office?"

Dr. York: "By and large the basis of my office will be people from Foote's office and Holaday's office."

Mrs. Oswald: "Couldn't the same thing be done with ARPA?"

At this point Dr. York decided "it is always possible that these things will evolve." Perhaps it came to mind, as it did to the press, that Sentry, for example, was originally an Air Force program and there are people in the Air Force who developed a familiarity with it long before ARPA was born as an emergency expedient.

A press-room bull session later disclosed some reporters thought Dr. York intends to keep ARPA forever. Others thought he carefully propped open a door through which he can kick it, if and when he wants to.

A couple of weeks after Dr. York's induction there was a provocative speech made in Washington by Orval Cook, retired USAF general and president of the Aircraft Industries Association. About a year earlier, General Cook had declared there was no need for more committees, more agencies, more coordinators. The Pentagon reply to this advice was the formation of ARPA, announced on February 7, 1958.

Now, says General Cook in early 1959, "the proper people in government should carefully analyze all agencies and departments which have large scientific and engineering staffs to determine whether we have too many scientists and engineers looking over the shoulders of other scientists and engineers.

". . . unnecessary checks and counterchecks, through many administrative layers, only add confusion, and waste the one irreplaceable factor—time."

Dr. York says he is here to speed things up, to expedite research, make sure the field is covered, and cut out duplication. We hope he does these things and takes some advice from General Cook on how they can be accomplished.

Digging for the Fiscal Facts

For all the serious work put in on the federal budget and the storms that are stirred up over what it will provide, it is a little incredible how some of the facts are transmitted to the public. Each year, on the Saturday before the White House sends the budget to Congress, there is a head-knocking session for the press in the Pentagon. The material is for use without attribution, is intended to ensure intelligent discussion of the defense budget in the following Monday afternoon's papers.

The Seminar on fiscal '60, which met a few hours before this issue of AIR FORCE went to press, was no different from the others we have attended in past years. There were the usual fatuous questions from people like the lady reporter who could not understand why there is no provision for the Army, Navy, and Air Force to pay the new increased tax on motor fuel. There is always the reporter who tries to nail down a Defense Department statistician on the prospect for a new Reserve Armory in East Overshoe, Ohio.

On the more solid side, this year we uncovered some interesting arithmetical sleight-of-hand. President Eisenhower, it was pointed out, said in his State-of-the-Union message we are spending close to $7 billion on missile programs in fiscal 1959. The Defense Department's figures show anticipated expenditures of $3.3 billion, expected to hit $3.8 billion in fiscal 1960. How, please? The answer is that the White House total included everything that goes into the weapon systems, submarines for the Polaris, tenders for those submarines, and supplies for those tenders. It counted the cement poured at USAF missile bases, the countdown machinery, and the station wagons that carry observers out to the Atlas gantry crane.

Other queries brought out that USAF's Minuteman ICBM program was accelerated last year, as Congress demanded, but the money provided for the purpose has not been spent because the Pentagon had cash left from another project. It appeared there are even some members of the Armed Services Committees on the Hill who don't know that.

At this writing it is too early to provide a sensible commentary on the new budget and the arguments raging around it. We are looking forward to a noisy but fascinating storm. Whatever its failing, we think the American people should thank their stars for the Washington press corps and its insatiable and impolite curiosity.—END

New NASHVILLE Division

Structures for tomorrow's aircraft and missiles

To make ready for the future, Avco Manufacturing Corporation has created a new division at its Nashville plant devoted to design, development and production of aircraft and missile structures and assemblies.

Avco's new Nashville Division (formerly a part of the Crosley Division) boasts an enviable 17-year record of building components for some of the country's most important aircraft, including the B-52, B-47 and B-36.

Today it produces components for these aircraft:

Convair 880 jet airliner—horizontal and vertical stabilizer; wing tip, leading and trailing edges and flaps.

C-130 Hercules transport—complete empennage.

F-102 Delta Dagger—wing trailing edge.

F9F Cougar—horizontal stabilizer, flaperons and flaperettes.

Looking ahead, the Nashville Division has prepared itself to contribute to the Mach 3 aircraft and Mach 10 missiles that soon will go into production as part of the nation's defense effort.

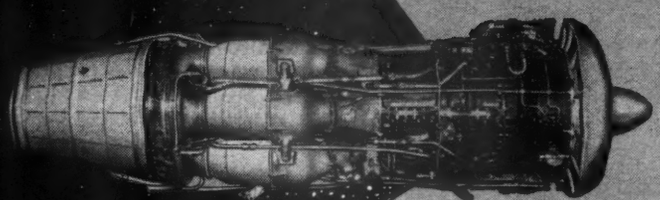
The Nashville Division's skilled personnel have demonstrated their know-how in producing Avcomb, contoured stainless steel honeycomb panels. They long ago proved themselves in the production of aluminum honeycomb structures, and other advanced manufacturing techniques, such as metal bonding and chemical milling.

Avco/Nashville:
proven . . . ready for tomorrow

For further information, write: General Marketing Manager—Structures, Nashville Division, Avco Manufacturing Corporation, Nashville, Tennessee.

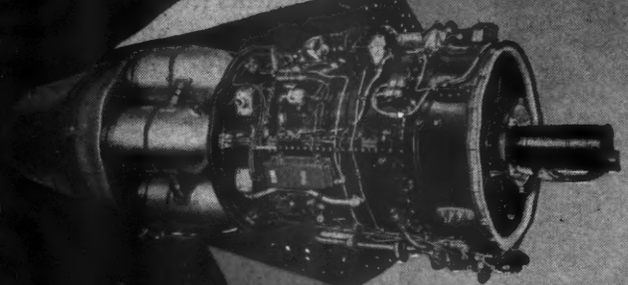
Avco / Nashville

MORE POWER by ORENDA



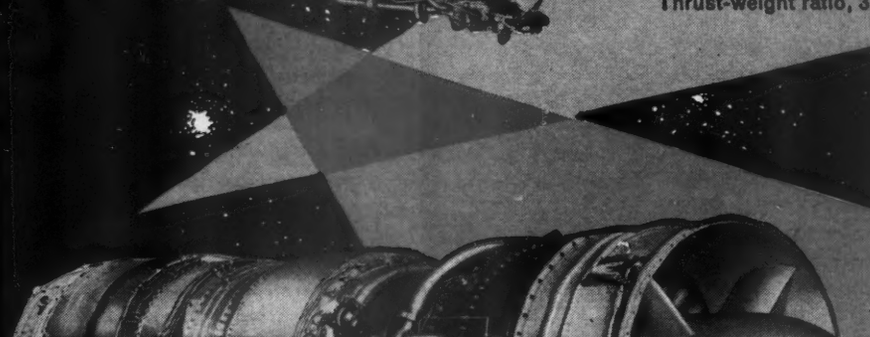
CHINOOK

Canada's first gas turbine engine was initially run on March 17, 1948 at 2600 lbs. thrust. Thrust-weight ratio developed to 2:1.



ORENDA

First run on February 10, 1949. More than one million hours of operational service to date in CF-100's and Sabres of the RCAF, West German, Belgian, South African, and Colombian air forces. Thrust-weight ratio, 3:1.



IROQUOIS

First run December 15, 1954. First production Iroquois are for the AVRO ARROW Mark II. Thrust-weight ratio, 5:1

Orenda Engines Limited salutes the 50th Anniversary of powered flight in Canada

ORENDA ENGINES LIMITED, MALTON, CANADA • MEMBER: A. V. ROE CANADA LIMITED & THE HAWKER SIDDELEY GROUP

FLIGHT LINES

USAF **Lockheed F-104 Starfighters** of the Air Defense Command *set seven new time-to-climb records* at Point Mugu, Calif., last December 18. Holder of the **world's speed record of 1,404 mph,** and the **world's altitude record** of **91,243 feet,** the Starfighter became the first airplane to **hold records in all three categories.**

Two Western Air Defense Force pilots, **1st Lts. William T. Smith** of Mount Carmel, Conn., and **Einar N. Enevold-son** of Moses Lake, Wash., both of the **538th Fighter-Interceptor Squadron,** set the time-to-climb marks with skyrocket zooms into the stratosphere. The 538th, at Larson AFB, Wash., is a unit of the 25th Air Division (Defense) with headquarters at McChord AFB, Tacoma, Wash. As timed by National Aeronautic Association officials, the new records are:

METERS	OLD RECORD	NEW RECORD
3,000	44.39 sec.	41.85 sec.
6,000	1 min. 6.13 sec.	58.41 sec.
9,000	1 min. 29 sec.	1 min. 21.14 sec.
12,000	1 min. 52 sec.	1 min. 39.9 sec.
15,000	2 min. 36 sec.	2 min. 11.1 sec.
20,000	none	3 min. 42.99 sec.
25,000	none	4 min. 26.03 sec.

The runs were made with two flight profiles. For the five lower-level marks, the Starfighters thundered down the Point Mugu runway, gained all possible speed before takeoff, then pulled up sharply to roar skyward with the added boost of afterburner thrust. In the two high-altitude climbs the Starfighters were pulled off the runway as quickly as possible, leveled off at a moderate altitude to gain speed in a forward dash, and then streaked upward in a rapid climb.

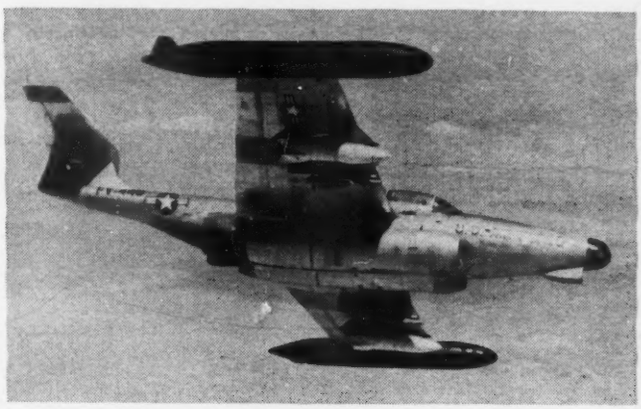
Other record-setters, Starfighter pilots **Capt. Maurice A. Shaff, Jr.,** from Urbana, Ill., and **Capt. Bruce D. Jones,** from Lodi, Calif., both of the **538th Fighter-Interceptor Squadron,** proved that F-104s can scramble, intercept, and destroy a **target plane 172 statute miles away** and flying at **35,000 feet**—all in **less than nine minutes.**

Two SM-75 **Thor IRBMs** were fired **3,000 miles apart,** from **Cape Canaveral** in Fla., and from newly activated **Vandenberg AFB** range in Calif., last December 16. The Vandenberg firing, the first at the new SAC missile training center, was **conducted by a regular Air Force crew.** The missile blasted off **eleven minutes after fueling** was begun. Both tests were full-range firings of the 1,500-mile missile, and no attempt was made to recover the nose cones. Both missiles were reported to have gone the **full distance,** 1,500 miles, to preselected target areas.

The contract for the **J-83 engine,** which has been under development at **Fairchild Engine & Airplane Corp.,** Deer Park, Long Island, N. Y., has been canceled by USAF. The J-83 engine was primarily designed to be the power-plant for the **ground-launched Goose** decoy missile, which was canceled last month.

First prize of $350 in the **seventh annual Air Force short-story contest** went to **Maj. William E. Carigan, Jr.,** stationed at Headquarters, Iceland Air Defense Force, Keflavik, Iceland, a MATS activity. **Capt. Ralph D. Messer,** assigned to March AFB, Calif., received the second prize, $250. Third prize, $150, went to **Airman Donald G. Connant** of USAF Security Service. **Capt. Thomas J. Slaybaugh,** Hq. MATS, Scott AFB, Ill., won the fourth prize, $100, and **Lt. Thomas A. Buckner III,** Alaskan Air Command, was awarded the $50 fifth prize.

Judges for the contest were **John Cheever,** short-story writer and author of the *Wapshot Chronicle;* **Virgilia Peterson,** book reviewer and lecturer; **Bennett Cerf,** publisher, panelist, and author of *Reading for Pleasure;* **Clay Blair, Jr.,** *Saturday Evening Post* editor and author of *Beyond Courage;* and **Nancy Hale,** author of *Heaven and Hardpan Farm.*



MB-1, the Genie, Douglas air-to-air, rocket-powered missile, carrying a nuclear warhead, is carried under the wing of a Northrop F-89J Scorpion. The Genie can also be stowed in the missile bay of the F-101, F-102, or F-106. Some units of ADC already are equipped with the nuclear Genie.

A **Douglas C-133 Cargomaster** of the **Military Air Transport Service airlifted the heaviest load in the history of aviation** on December 16 of last year at Dover Air Force Base, Del. The **275,000-pound four-engine turbo-prop transport** lifted **117,900 pounds of payload** to an **altitude of 10,000 feet. Operation Big Lift,** commanded by **Brig. Gen. Robert J. Geowey** of the 1607th Air Transport Wing (Heavy), far exceeded the previous record of 78,089 pounds airlifted in September 1958, and is almost three times the former world record made by a Soviet TU-104 in 1957.

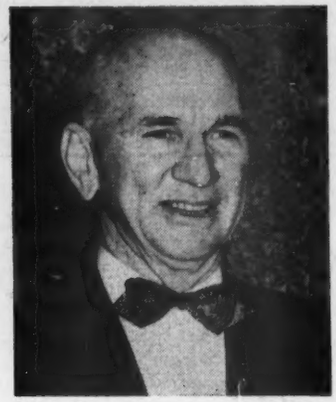
The record airlift was officially certified by the **National Aeronautic Association's** Carl R. Wheeley, who checked the weighing of the load and was on board the C-133 during the fight. The NAA is the US representative of the Fédération Aeronautique Internationale, which must certify the flight before it is established as a world record.

New Officers: Thomas G. Lanphier, vice president and assistant to the president of Convair Division of General

(Continued on following page)

James T. Pyle

Maj. Gen. John Henebry



Maj. Gen. Clements McMullen

Maj. Gen. Clements McMullen, USAFR, died on January 9, at Lackland AFB, Tex., after a long illness. General McMullen's air career began when he enlisted in the Army in 1917 and was assigned as an air cadet. Among his World War II service was command of the Far East Air Service Command, when General Kenney described him as "tops in the . . . field and a personal friend of twenty-five years' standing." General McMullen was an active civic worker and a member of the AFA for eleven years.

Dynamics Corp., was reelected to serve a **sixth consecutive term as president of the National Aeronautic Association.** Also reelected were **Miss Jacqueline Cochran,** 1st vice president; **Mrs. M. T. Davis,** Secretary; **Edward C. Sweeney,** Treasurer; **Charles S. Logsdon,** Executive Secretary and assistant secretary-treasurer.

The **Council of the International Civil Aviation Organization,** a specialized agency of the United Nations, has selected **Ronald M. Macdonnell,** Deputy Under-Secretary of the Canadian Department of External Affairs, to be **Secretary General of the ICAO.** Mr. Macdonnell will succeed **Carl Ljungberg** of Sweden as Secretary General at the twelfth session of the ICAO assembly, which will be held in San Diego next June.

William Littlewood, Vice President for Equipment Research for American Airlines and IAS Honorary Fellow for 1957, was elected President of the Institute of the Aeronautical Sciences for 1959, succeeding **Edward C. Wells,** Vice President and General Manager of the Systems Management Office of Boeing Airplane Co. Littlewood has been a director of the Cornell Aeronautical Laboratory since 1948 and received the Daniel Guggenheim Medal for 1958.

James T. Pyle, Administrator of the **Civil Aeronautics Administration** since 1956 (*see cut*), was chosen by President Eisenhower to be **deputy to Elwood Quesada** in the new **Federal Aviation Agency** that has absorbed the CAA, the rule-making functions of the Civil Aeronautics Board, and most of the Airways Modernization Board. Mr. Pyle came to Washington in 1953 on the staff of the Assistant Secretary of the Navy after many years with Pan American Airways and World War II duty with the Navy. He became deputy chief of the CAA in 1956 and administrator later that year.

Other FAA aides appointed recently:

J. Gordon Bennett, who was executive assistant to Mr. Quesada when he was Special Assistant to the President, has been named Special Assistant to the Administrator.

Alan L. Dean, who was a senior management analyst with the Bureau of the Budget, will be the Assistant Administrator.

John R. MacKenzie, who served as Congressional Liaison Officer for the Department of Health, Education, and Welfare, has been named Chief of the Office of Legislative Liaison.

William B. Davis, who was Deputy Administrator of the CAA, to be Director of the Flight Standards Bureau.

David C. Thomas, formerly director of the CAA Office of Air Traffic Control, will be director of the FAA Bureau of Air Traffic Management.

Maj. Gen. John P. Henebry, USAFR, who was president of **Skymotive, Inc.,** in Chicago, Ill., is **now president and a director of the Chicago Barrett Corp.,** engaged in engineering, development, and manufacture of electronics, electromechanical, and electrochemical products, with its plant in Lyons, Ill. General "Jock" Henebry (*see cut*) served with the Air Forces in the Pacific in World War II and commanded the Combat Cargo Command, **315th Air Division during the Korean War. He was president of the Air Reserve Association** before it merged with AFA in 1953; he served twice as **chairman of the Air Staff Committee on Reserve Policy;** he is a charter member of AFA, served three times on the Board of Directors, and was **AFA President in 1956-1957.** General Henebry is currently **Chairman of the AFA Board of Directors.**

STAFF CHANGES . . . **Brig. Gen. William R. Large, Jr.,** former Assistant CinC SAC, SAC-Mike, Inglewood, Calif., is now Comdr, 706th Strategic Missile Wing, SAC, Francis E. Warren AFB, Wyo. . . . **Brig. Gen. Don Coupland,** who was Deputy Comdr for Ballistic Missiles, San Bernardino AMA, has become Director of Logistics Support Management at the same station.

At AMC, Wright-Patterson AFB, Ohio, **Brig. Gen. John C. McCawley** has been reassigned from duty as Chief, Manpower and Organization Division, Hq. AMC, to become Inspector General, replacing **Brig. Gen. Donald L. Hardy,** who will be Director of Personnel and Support Operations, AMC. The former Personnel and Support Operations Director, **Maj. Gen. Paul E. Ruestow,** will command the Middletown AMA, Olmsted AFB, Pa.

Brig. Gen. Charles E. Jung, Deputy Comdr, Oklahoma City AMA, Tinker AFB, Oklahoma City, Okla., has been reassigned as Comdr, Dayton AF Depot, Gentile AF Station, Dayton, Ohio. . . . **Brig. Gen. Lewis L. Mundell** has been promoted from Deputy Comdr, San Antonio AMA, Kelly AFB, Tex., to Comdr, succeeding retiring **Maj. Gen. Thetus C. Odom.**

Brig. Gen. Joseph H. Moore, CofS, Ninth AF, TAC, Shaw AFB, S. C., has been assigned as Comdr, 4th Tactical Fighter Wing, Seymour-Johnson AFB, Goldsboro, N. C. . . . **Brig. Gen. George S. Cassady** and **Brig. Gen. Marcus F. Cooper** have been assigned to the new Federal Aviation Agency, Washington, D. C. General Cassady, who had been Deputy Comdr, Eastern Transport AF, Fort Myer, Arlington, Va., will be Deputy Director of the Bureau of Air Traffic Management of FAA; and General Cooper, Comdr, AF Flight Test Center, Fort Myer, Arlington, Va., will be Assistant Administrator of the Office of Plans and Requirements, FAA.

—MICHAEL B. MILLER

DETECTION

LMED'S airborne **GENDARME** will illuminate the unknown

One or many, in clouds or clutter . . . nothing will elude GENDARME, LMED'S new *Airborne Early Warning and Control radar. New AMTI (Airborne Moving Target Indication) and Pulse Compression techniques sharply curtail sea clutter, improve target detection. New "built-in" height finding provides a truly 3-D search system. New data processing methods insure completely automatic operation. For further news on LMED's detection developments write for brochure: "Airborne Detection . . . in Search of Time," **Dept. 7A.**

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OFFICIAL CONVENTION HOTELS—Pictured above are the twenty-one hotels, of the more than 300 in Miami Beach, that have set aside some 3,000 rooms for AFA's 1959 National Convention and Aerospace Panorama. All twenty-one of the hotels are air-conditioned, each has an ocean beach and a swimming pool, and all are located within a five-minute cab ride of the Auditorium and Exhibition Hall, where the Panorama and many of the Convention events will be held. The numbers on the map above indicate the location of the hotels along Collins Avenue, main thoroughfare of Miami Beach. Most of AFA's hotels are new, all are first class, and it would be difficult to suggest a "best one"—they are all good.

Make your Hotel Reservation Now for

AIR FORCE ASSOCIATION's 1959

Convention and Aerospace Panorama

MIAMI BEACH, FLORIDA • SEPTEMBER 3-4-5-6

AFA Convention Hotels Rates

HOTELS	SINGLE	TWIN	1 B/R SUITE	2 B/R SUITE
DI LIDO	$12	$12	$28	
SHELBORNE	$10	$12	$15	$45
NAUTILUS	$8	$10	$22	
SHORE CLUB	$7-8	$7-8	$15	$22
RONEY PLAZA	$8-12	$10-16	$30	$45-60
ALGIERS	$9-11	$11-13	$26	
SEVILLE	$10-12	$14	$28	$42
SEA ISLE	$8-10	$12	$20	$36
SANS SOUCI	$12	$12	$24	
SAXONY	$9-10	$11-12	$22-24	$33-36
VERSAILLES	$10	$10	$20	
CADILLAC	$8	$10	$20	$30
CROWN	$8	$10	$20	$30
LUCERNE	$8	$10	$25	$35
SAN MARINO	$8	$10	$24	$30
EMPRESS	$8	$10	$20	
BARCELONA	$8-10	$8-10	$20	
SORRENTO	$8-12	$8-12	$20-24	
FONTAINEBLEAU	$16-22	$16-22	$40-45	$80
EDEN ROC	$14	$16	$40-56	$72
MONTMARTRE	$12-16	$12-16	$28-32	$42-48

Single Rooms Scarce

As is the case in most resort cities, Miami Beach hotels have very few single rooms. Some hotels have double rooms (one large bed), but most of the rooms are twins (two beds). A limited number of double and twin rooms are available for single occupancy; however, it is hoped that the majority of persons will arrange to share a twin room.

Send your reservation to:
AFA HOUSING BUREAU
P. O. BOX 1511
MIAMI BEACH, FLORIDA

TWENTY-ONE Miami Beach hotels have set aside more than 3,000 rooms for the Air Force Association's 1959 National Convention and Aerospace Panorama, which will be held September 3-4-5-6. If the 3,000 rooms run out, it will present no problem—Miami Beach boasts more than 300 hotels. Actually, the Beach is like one big sprawling hotel; many of the hotels are next door to each other, some only a short block away.

Miami Beach hotels are not large, in terms of numbers of rooms each. Most of the hotels on the Beach have around 300 rooms; only a few have more than 500. Just two hotels have set aside 300 rooms for AFA; the others from 100 to 250 rooms each. This means that those attending the Convention and Panorama will be staying in more hotels than at any previous AFA Convention; however, they actually will be closer together than in any other city.

A big change will be made in the 1959 Convention schedule. You will note that the dates are September 3-4-5-6—Labor Day weekend—Labor Day being the 7th. Actually, the official program will cover only three days—Thursday, Friday, and Saturday, September 3, 4, and 5. There will be an AFA Leaders meeting and a Board of Directors meeting on Tuesday, September 2, and the Panorama will remain open to the public on Sunday, September 6. This schedule will make it possible to attend the entire Convention, travel on Sunday, and spend Labor Day at home.

CLIP & MAIL YOUR RESERVATION TODAY!

1959 Air Force Association Convention & Panorama

Type or Print NAME_____ RANK, IF MILITARY_____

ADDRESS_____

CITY & STATE_____

1st Choice Hotel _____ 2d Choice Hotel _____ 3d Choice Hotel _____

Type Room—Be specific on double or twin room. _____ Desired Rate _____

Others Sharing Room _____

Arrival Date and Hour _____ Departure Date _____

VIEWS & COMMENTS

What Is the Price of Survival?

THERE is the very real possibility that, if present trends continue, the Soviet bloc will within a few years have a decisive military advantage over the United States and its allies. This frightening possibility arises not only from the intensified military development efforts of the Soviet Union but also from serious limitations and lags in US defense concepts and programs. . . .

In spite of many reassuring statements, the feeling persists that the position of the non-Soviet world, and notably of the United States, has been materially weakened by the inadequacy of its response to the ever-growing challenge of the Communist bloc. The longer this process is allowed to continue, the greater [the] peril. . . .

There seems still to be little recognition of the fact that, desirable as a balanced or approximately balanced budget is in normal times, to seek it above all else in the circumstances of today may prove the prelude to disaster. For this is no peacetime budget with which the American people are presently concerned. It is a budget to ensure the successful conduct of US foreign policy under the conditions of the "cold war." And, although this would be far less burdensome than the budgetary exactions of a "shooting war," it is a profound mistake to think that expenditures can prudently be held in the straitjacket which peacetime fiscal measures would properly impose.

The argument is often heard that the United States cannot afford even the present inadequate level of defense expenditures and that, if it is long continued, the American economy will collapse, thereby enabling the Soviets to triumph without war. Hence, it is concluded, the best defense against the Communist threat of world domination is a reduced and balanced US budget. It is high time that the American people realized the dangerous fallacies inherent in this argument. . . . The United States could afford substantially higher budgetary expenditures if national economic policies were adopted which would enable the American economy to achieve more of its truly enormous growth potential. With an adequate rate of economic growth, the US economy could afford a larger budget not only for increased military defense expenditures but also for the greater social capital investments necessary to sustain economic growth. With little less than national survival at stake, it would be a critical mistake to make a fetish of arbitrary . . . limitations.

But the argument against adequate military expenditures contains another fallacy, even more dangerous. For it must by now be obvious to every open-minded American that the successful conduct of US foreign policy at a time when all the cherished values of Western civilization are challenged as never before depends upon the adequacy of American military preparedness. . . .

—From National Planning Association's "An Adequate Military Shield for US Foreign Policy," issued at year's end, 1958.

The State-of-the-Union Message

GRANTED that the President's first message to Congress is bound to be rather general in character, what the President had to say on Friday throws very little light indeed on the state of the union. He said in effect that we are "ceaselessly challenged" and that in meeting this challenge all that we can afford to do, without raising taxes, is all that we need to do.

This is a remarkable coincidence—that we are able to meet so great a challenge without any additional effort and sacrifice during the coming fiscal year, and that in the following year we may be able to relax and to reduce taxes. We are confronted, said Mr. Eisenhower, with a question which is "as old as history," whether a government based upon liberty can endure when it is ceaselessly challenged by a dictatorship with growing economic and military power. And what is the answer to this question which is as old as history? It is that we can indeed endure by doing no more than we are doing now.

But just what is the use of asking this tremendous question about whether we can endure if the answer is that we are already doing all that is necessary? The explanation, I am afraid, is that the President is trying to ride two horses at once—to be hard when he talks to Moscow and soft when he talks to our own people. We are to defy the challenge abroad and reduce taxes at home.

This does not sound as if the President expected the nation to take the ceaseless challenge very seriously. For if it is true, as in fact it is, that the Soviet Union is challenging us with "an economic and military power of great and *growing* (italics supplied) strength," how is it conceivable that we can look forward to a tax reduction just before the coming national presidential election? This is the kind of softness and self-indulgence which is "as old as history," and again and again in history has meant the ruin of great states.

To be hard on the outside and soft on the inside is to invite trouble. For this is a changing world in which the power and the influence of the challenger are growing. We cannot long hope to succeed in meeting this challenge by a policy of standing pat in all things—on all of our positions abroad and on our efforts at home.

The right position is that of Churchill's when he said "we arm to parley." We should arm more strongly and we should negotiate more readily. We should be not inflexible, but we should be tough, remembering that what is inflexible is usually brittle.

—Walter Lippmann, from his column, "Today and Tomorrow," January 13, reprinted with permission of the New York Herald Tribune, *copyright 1959, the New York* Herald Tribune.

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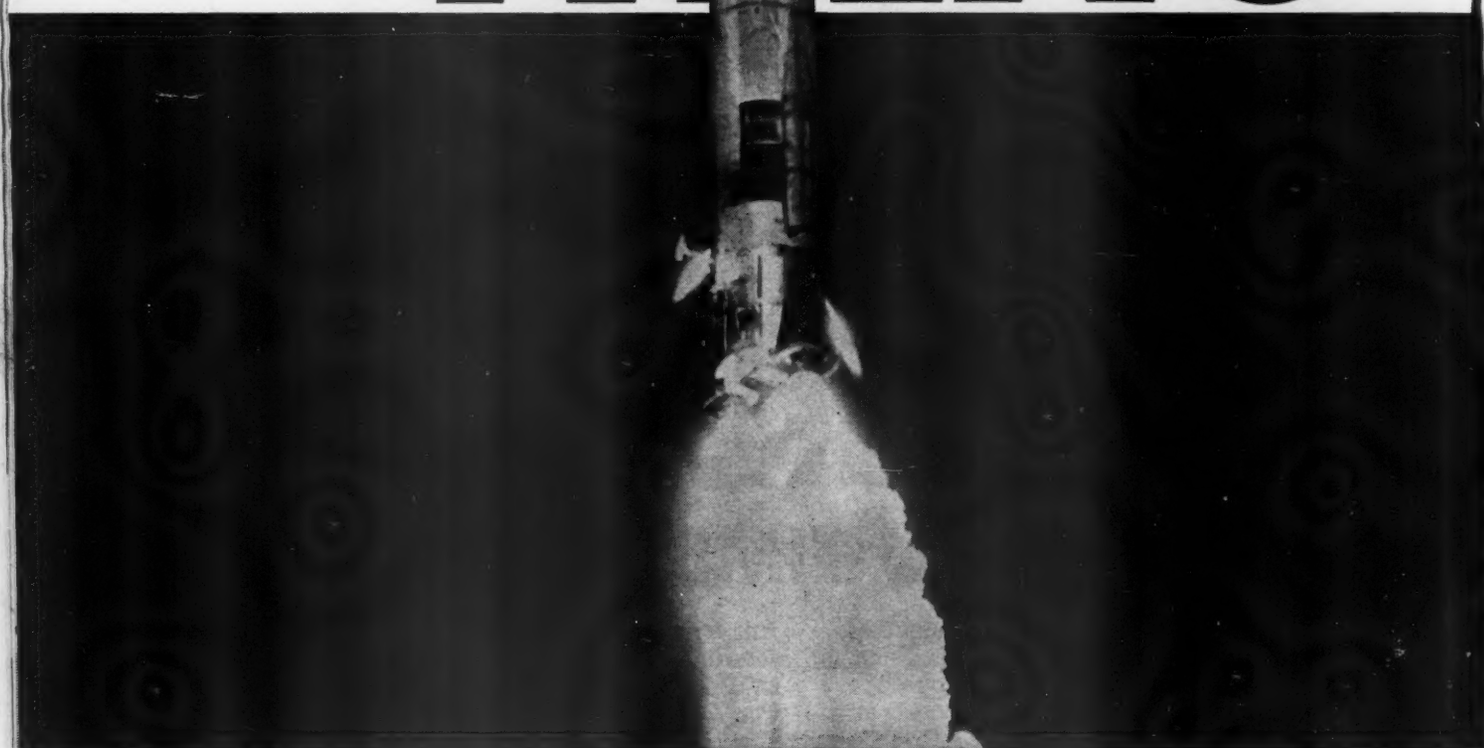
Preserver of Peace . . .

ATLAS

Air Force "Sunday Punch"



Boosted into space by the fiery thrust of three huge rocket engines, the seven-story Atlas intercontinental ballistic missile roars upward from its Cape Canaveral launching pad. Quickly it sheds the frost encrusting the liquid oxygen tank and races to its predetermined destination in the far reaches of the globe. In its size and range and capability, the Air Force Atlas is a commentary, for all the world to heed, of the necessity to maintain the peace. RCA's Missile and Surface Radar Department has been privileged to design and develop ground check-out, launch control and cabling equipment as a major subcontractor to Convair (Astronautics) Division of General Dynamics Corporation, the Atlas prime weapons systems contractor.

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DEFENSE ELECTRONIC PRODUCTS

CAMDEN, N. J.

On Scientific Advances

IT MUST be appreciated that the greatest advances in fundamental science are almost always traceable to the work of a single exceptional individual. There is no substitute for talent; neither two men nor ten of lesser abilities can be expected to achieve what can be accomplished by a superior individual. While this is not always explicitly recognized, and the promise of a research effort is often related to its budget and its population, a very brief examination of the past is sufficient to emphasize the overwhelming importance of individual quality.

Another requirement for success in research is consistency of support. Most programs of fundamental research do not involve large levels of expenditure, at least in the terms which are becoming familiar to the Department of Defense, but success almost always depends upon the continuous provision of funds for a stable level of effort during the whole period in which the research program can profitably be pursued. A relatively small stable program is likely to yield much better results in absolute terms—and tremendously greater value per dollar expended—than will a program involving much more money spent in stop-and-go fashion.

Not only is continuity of financial support required; consistency in the manning of a fundamental research effort is also very desirable. In defense industry, there are often emergencies in military development programs which appear to demand the assignment to the task of every available individual, and these recurrent "flaps" are frequently permitted to disturb the assignment of senior technical people to programs of fundamental research. Of course, doing the main job successfully is of primary importance, but both the research director and the military customer should clearly recognize the immense importance of the long-range fundamental work, as well as that of the more immediate work on weapons development.

Finally, [there is] a rather surprising requirement for successful industrial prosecution of fundamental research. Before being connected with research in industry, I would not have guessed that this requirement existed. I refer to the keen desire of the industrial research worker to see practical applications made of the advances in knowledge to which he has contributed. This is a bit of contradiction; we defined fundamental research as being work undertaken without immediate regard to application. Now I am asserting that vigorous attention to applying the results of fundamental research is an important factor in mounting and sustaining a successful and effective research program. And so I believe it to be. While the research scientist cherishes his "ivory tower" in the sense that he wants proper working conditions and freedom from day-to-day demands on his purposes and efforts, at the same time he is aware that he is part of a technical industry and he desires to contribute to the advancement of that industry. The industrial research laboratory should never be too far out of the main stream of progress in the industry supporting it, and which it supports. . . .

—From an address by Dr. Louis N. Ridenour, Assistant General Manager, Research, Missile Systems Division, Lockheed Aircraft Corporation, Sunnyvale and Palo Alto, Calif. Presented at the Fortieth Meeting of the American Ordnance Association, December 3, 1958.

Those Secret Experiments

THE almost universal delight at the triumphantly orbiting Atlas surely will all but drown out any misgivings inspired by the way in which the Defense Department handled the information about it. If propaganda consequences are all that interest us, a strong case can be made out of the public-relations operations. The very element of surprise contributed, no doubt, to world excitement over the launching, and therefore multiplied the impact.

But is propaganda all that we are interested in? And ought we to achieve propaganda successes by means that menace the survival of free institutions and eliminate all the ordinary checks that a popular government has on governmental integrity, efficiency, and economy?

When the government announces in advance details of its plans and expectations, it does run the risk that its officers will be exposed to criticism if plans are not carried out or expectations are not realized. Propaganda defeats then are suffered. They are made infinitely worse, of course, if boasts are made about what we intend to achieve. The advance boasts ought to be avoided, but should all advance information be withheld or suppressed? Is there not something to be gained from thoughtful reporting of the meaning of such achievements—very difficult in the circumstances of Atlas—or from maintaining our reputation abroad for candor even about our failures?

Millions, even billions, of dollars are involved in these programs. Should citizens have no check on the honesty or efficiency with which they are carried out? Under the Atlas system, an agency might make a hundred unsuccessful orbit efforts and explain them all away as routine testing shots. No one except those having access to classified information would know of the waste involved. No one but a privileged élite would know that equipment costing billions was improperly designed or constructed.

The knowledge in any case must be limited, but is it safe to throw the cloak of secrecy about fallible human beings having the disposition of such enormous sums of money? Citizens pay for the failures. Have they no right even to learn of them?

There is another risk. Science now has the capacity to launch experiments involving real threats to human life, in this country and elsewhere. Is it safe to put into the hands of a few persons, operating secretly, the power to undertake experiments that might change the environment of the whole human race, without even an intimation to ordinary citizens?

The people of a democratically governed country need to know in advance enough about such experiments to be able to judge, afterward, whether they succeeded or failed; and they need to know enough about them to make decisions within lay competence on whether society wishes to take the risks involved in ventures that might imperil mankind.—*Washington* Post and Times Herald, *December 21, 1958.*

SHOOTING THE BREEZE

WITH THE EDITORS OF AIR FORCE MAGAZINE

AIR FORCE/SPACE DIGEST and the Air Force Association this month welcome aboard a new West Coast sales manager, Harold L. Keeler. Keeler (*see cut*) joins AFA from the Los Angeles industrial management and marketing firm of Cromwell & Riley, of which he was vice president. He brings with him more than twenty years' experience in sales promotion, market research and related areas. Keeler spent eleven years with McGraw-Hill Publications and five each with the *Wall Street Journal* and Philip Andrews Publishing Co. He dealt with major airframe and subcontractor advertising for the last concern. Keeler, who studied at the University of Wisconsin, belongs to the National Industrial Advertising Association and the Los Angeles Chamber of Commerce's Industrial Marketing Conference panel.

AIR FORCE/SPACE DIGEST's other West Coast sales representative, Hugh K. Myers, remains on the job along with Keeler at the Los Angeles office.

☆

The glimpse into USAF's "Head Shed" in last month's issue of AIR FORCE (*pages 42 and 43*) has aroused our nosiness about some other offices in the Pentagon. Our pictures showed you what is found in the offices of Generals White and LeMay. Well, we have since paid a visit to the lair of Defense Secretary Neil H. McElroy and thought you might be interested in some of the scenery down there, one floor below USAF's Chief of Staff and Vice Chief of Staff.

Most prominent on the McElroy desk is a copy, well-thumbed, of the *Pocket Congressional Directory.* On a huge table behind the Secretary's desk are pictures of President Eisenhower and Charlie Wilson, McElroy's predecessor. Both are suitably inscribed. Overhead there is a fine portrait of James Forrestal, the first Defense Secretary.

Like many other offices, there is a motto on a placard: "Pushing panic buttons does NOT solve problems." There is a copy of Dr. Kissinger's book on nuclear war, the *Forrestal Diaries,* and the Budget of the United States. There are a couple of heavy volumes on religion. We could read the title of only one. It was *Secrets of Religion Down Through the Ages.*

☆

A mighty missile was snowed in at Liberal, Kan., early last month. A blanket of security as thick as the snow kept details out of the public domain, but this basically was what happened:

A super-size truck with steering wheels fore and aft was hauling a missile about eighty-five feet long, described by eyewitnesses as "bottle-shaped," along Highway 54 in Kansas. New snow fell through the day on top of six inches of snow and ice already down, making the going rough and finally bringing traffic in the area to a halt.

The huge missile-bearing vehicle stopped in front of a motel, dwarfing the structure, and a four-man Air Force guard took station around it. Security-conscious, the guards declined to answer scores of questions hurled their way by onlookers who quickly gathered.

Thus was a Mach 20 missile halted by a few inches of snow.

☆

Free-lance contributor Everett Scrogin fires the following unguarded missive our way from Seattle, Washington:

Grounded—And How....

Oh, if I had the wings of a sparrow
From nowhere to nowhere I'd fly—
My wingspread would be much too narrow
For a fuselage heavy as I!

WALT WETTERBERG

"I suppose there's quite a story behind all this:"

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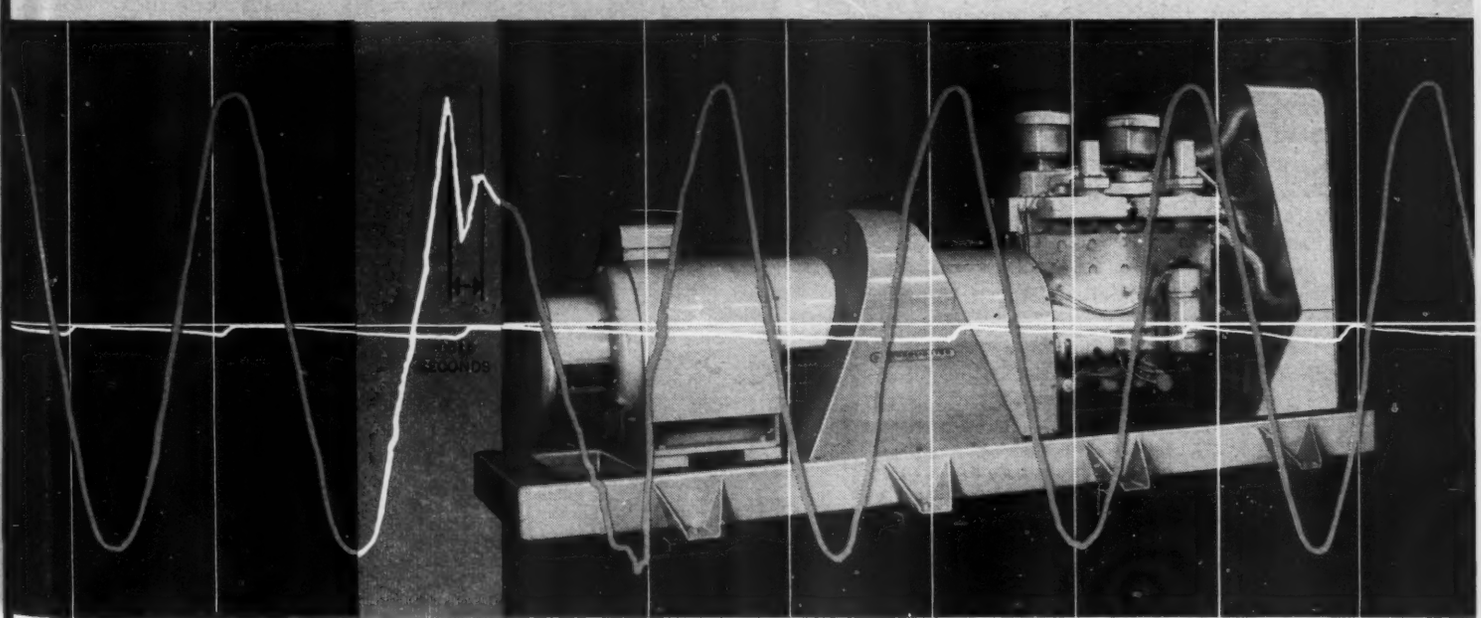
Basically the unit consists of a synchronous alternator and flywheel connected to a full diesel, liquid cooled engine, through a dry-type magnetic clutch. When in standby, the diesel does not run, thus greatly reducing operating and maintenance costs. The synchronous alternator and flywheel operate on prime power and when prime power fails or falls below established minimums Model UPS switchgear disconnects commercial power and energizes the magnetic clutch, causing the rotating flywheel to start the diesel. When commercial power returns to normal, the Model UPS will check its quality for a predetermined period, then automatically cut-out and return to its standby condition.



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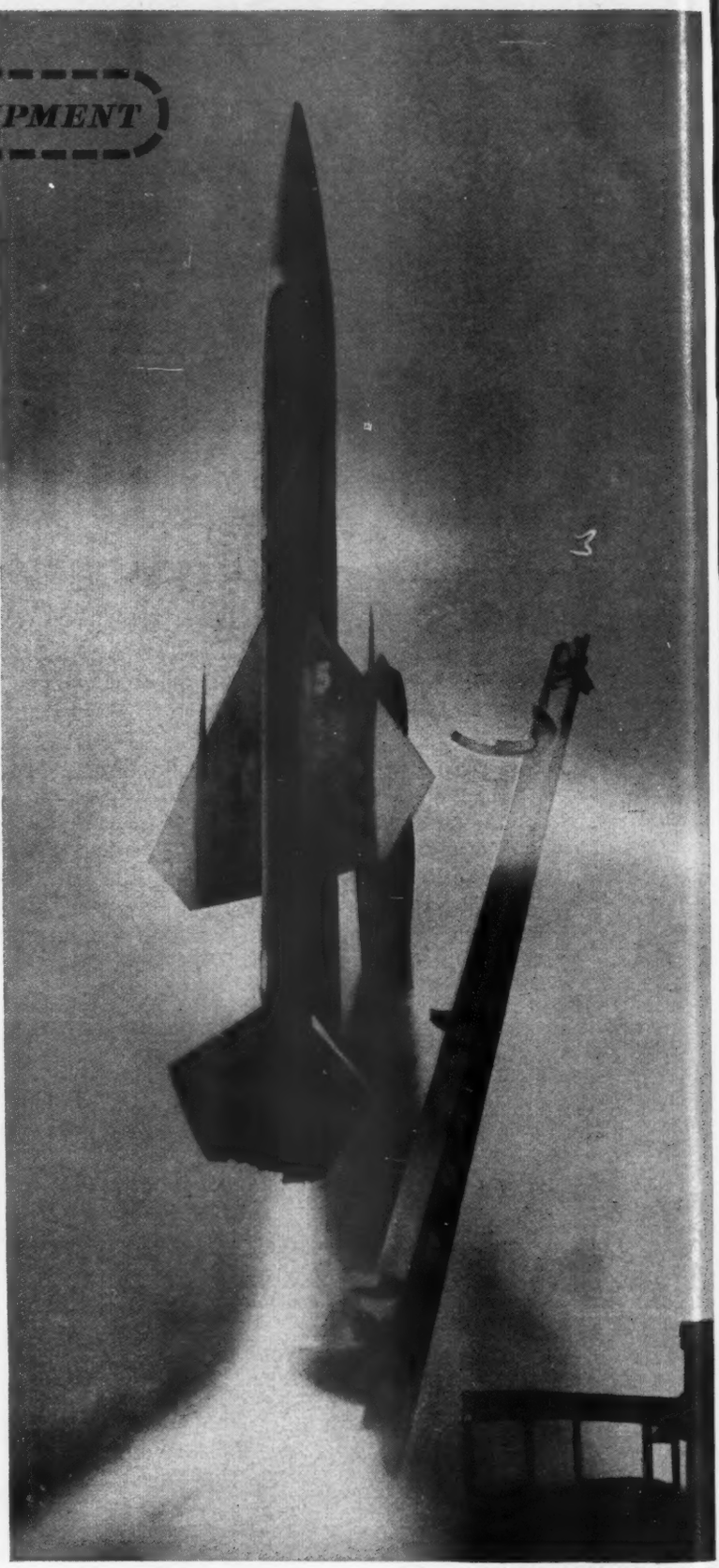

Operated by the Air Defense Command, a Boeing Bomarc climbs skyward from its launcher. FMC is building ground support equipment for this supersonic missile.

BOEING AIRPLANE COMPANY PHOTO

Putting Ideas to Work

FOOD MACHINERY AND CHEMICAL CORPORATION

Ordnance Division

Missile Equipment Section 5-L

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CAN JET BOMBERS ARMED WITH ALBMs MAKE SAC...

TOO TOUGH TO TACKLE?

THE MANNED airborne missile base, armed with a ballistic weapon, is technologically feasible right now and can add a new dimension to America's deterrent power in less than two years—if we work at it.

Recent test firings of ballistic missiles from manned bombers have proved that the concept is within the present state of the art. It is a concept that promises big dividends on economy grounds because it can extend the life of today's manned bombers by extending their utility.

But economy is by and large a fringe benefit, although a popular one these days. More importantly, the air-launched ballistic missile concept can, with a relatively small investment, provide Air Force operations experts with three advantages that interest them greatly—dispersal, mobility, and flexibility.

It has been pointed out many times—most recently by Albert Wohlstetter of the RAND Corporation in "The Delicate Balance of Terror," which appeared originally in *Foreign Affairs* and is reprinted beginning on page 48 of this issue of AIR FORCE—that we have a weakness for overselling new weapons and new military concepts. They almost never live up to early claims for their availability, costs, and performance.

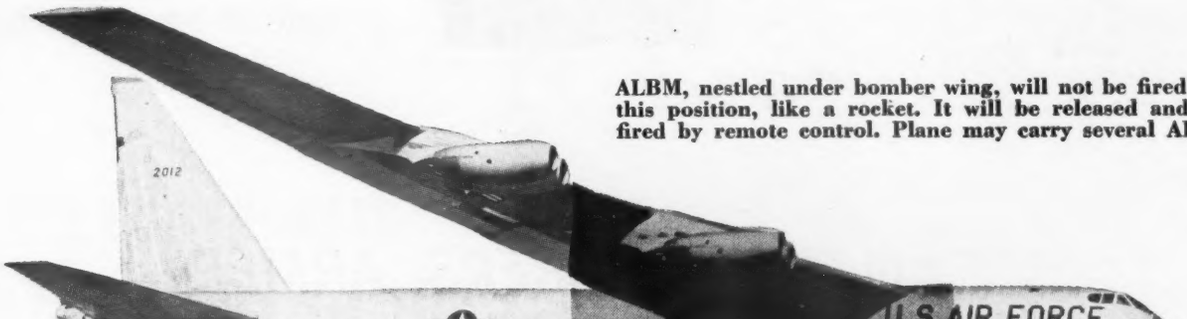
In the case of the airborne ballistic missile, however, there are key factors working in favor of an accelerated timetable. We have proven platforms. The Boeing B-47 and, more important, the B-52 are airborne missile bases if we choose to use them that way.

Recent tests, made from the B-47 and Convair's supersonic B-58, have proved the feasibility of developing a solid-fuel weapon that can be air-launched for ranges that

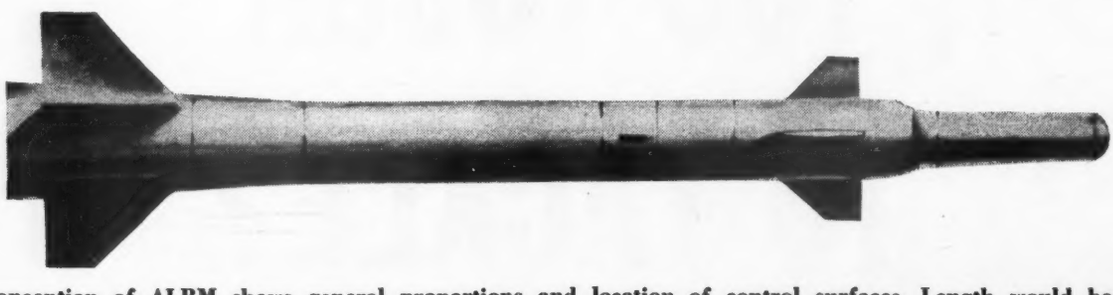
(Continued on following page)

Claude Witze
SENIOR EDITOR

TOO TOUGH TO TACKLE?



ALBM, nestled under bomber wing, will not be fired from this position, like a rocket. It will be released and then fired by remote control. Plane may carry several ALBMs.



Artist's conception of ALBM shows general proportions and location of control surfaces. Length would be about 25 feet. Much smaller than Navy's Polaris, it also weighs about one-half as much as the earlier and nonballistic Rascal. Head can be varied but should be able to deliver one megaton explosion. Stability, control are critical at blastoff.

may run in excess of 1,000 miles. The weapon would be, in effect, an air-launched cousin of the Navy's undersea Polaris. But it would be on a platform that is much faster, more elusive, and more flexible.

Facts are scarce about the exact nature of the test vehicles that have been fired. It is known that at least one version was put together from existing pieces of hardware and powered by off-the-shelf rockets. Refinements will not be difficult.

The point is, there is no doubt that this can be done. It can be done fast and cheaply in a day when slow progress and high costs are two major woes of the military existence. The Air Force has designated this weapon system WS-199. Study contracts have been completed, and a competition now is under way to pick a contractor who will develop the idea and produce a prototype for USAF evaluation. Early successes were scored by the Martin Company and a Lockheed-Convair team. Other contractors are interested in the development.

In March of 1958 AIR FORCE Magazine pointed out (*page 95*) that the air-launched ballistic missile has an obvious advantage over its ground-based counterpart. It can start its flight well above much of the earth's atmosphere, where less thrust is required to push the same payload over a given distance. There are a lot of other advantages, some of them less obvious. Many of them can be taken right out of the virtues heretofore attributed to the Navy's Polaris, to be launched from an underwater missile base, and from some of the weapons being devised for the Army, which also likes to emphasize mobility.

Consider, then, these attributes of the airborne missile base armed with an air-launched IRBM, a weapon system called ALBM, for Air-Launched Ballistic Missile:

● **ALBM will utilize existing equipment.** Adaptable to today's manned bombers, it can prolong the useful life of the B-47 and B-52, lend new lethality to the B-58, which will start becoming operational this year. It can use today's network of bomber bases, requiring nothing new but a relatively easy modification of the bombers and ground checkout devices. Air transportable, the ALBM would need no new or costly logistic arrangements.

● **ALBM is feasible within today's state of the art.** It has been made possible by advances in the field of solid-fuel propulsion, fathered by the Air Force and slated for use in the Polaris and in USAF's Minuteman ICBM program. A ratio of fuel to total weight has been achieved that two years ago was considered possible only with liquid fuels. Other improvements in structures and guidance have contributed to the achievement. Because it is feasible with existing components and carries the function of the manned aircraft one step further, to become a manned airborne missile base, there is no doubt that the Air Force can afford the new weapon even within the restrictions of a 1960 budget.

● **ALBM can make a major contribution to our deterrent power.** Most important, in the light of Dr. Wohlstetter's discussion (*page 48*) is the new flexibility it can give to the Strategic Air Command. If deterrent power

is to work, SAC must be too tough to tackle, and the balance, Wohlstetter says bluntly, is going to be precarious in the 1960s. One of the basic Air Force tenets is that our deterrent power cannot be concentrated in any one or even a few weapons, but must be as diversified as possible. This is one of the reasons for SAC's dispersal program, the airborne alert, and the constant effort to set up new fronts that the enemy must be prepared to handle before he can afford to press the button. It is the antithesis of the Maginot Line approach and would reach near perfection with constant patrols of supersonic ballistic missiles on supersonic missile bases. This is not to argue that ALBM is the perfect weapon. It is to argue that ALBM would be an exceptional complementary weapon.

• **ALBM would offer a major threat to the enemy defense capability.** This is a subject on which USAF is close-mouthed, but there have been many indications that Soviet defenses have improved in the past couple of years to the point where SAC has been forced to revise its estimates of the ability to penetrate. As Dr. Wohlstetter points out, large numbers of planes and missiles may be required. In weapons, as in other areas of human activity, there is always a point in the economic curve where diminishing returns are encountered. If the enemy did not know which aircraft aloft were missile bases and from which points they were prepared to launch and against which targets, the value of his defense system would start to diminish rapidly.

Added to this evasiveness is the ability of the manned airborne missile base to conduct repetitive attacks, to carry out more than a single sortie. The airborne ballistic missile will weigh in the neighborhood of 10,000 pounds, about twenty-five percent of the load capability of the B-52. While there are advantages to a high-altitude launch, above the drag of heavier atmosphere, there are other advantages to low altitudes, below the line of sight for enemy ground-based radar. With its range, ALBM could force the potential enemy to extend his defense line by another 1,000 miles. This is expensive and involves him in the political problem of the right to use certain polar regions and areas of open sea for this purpose.

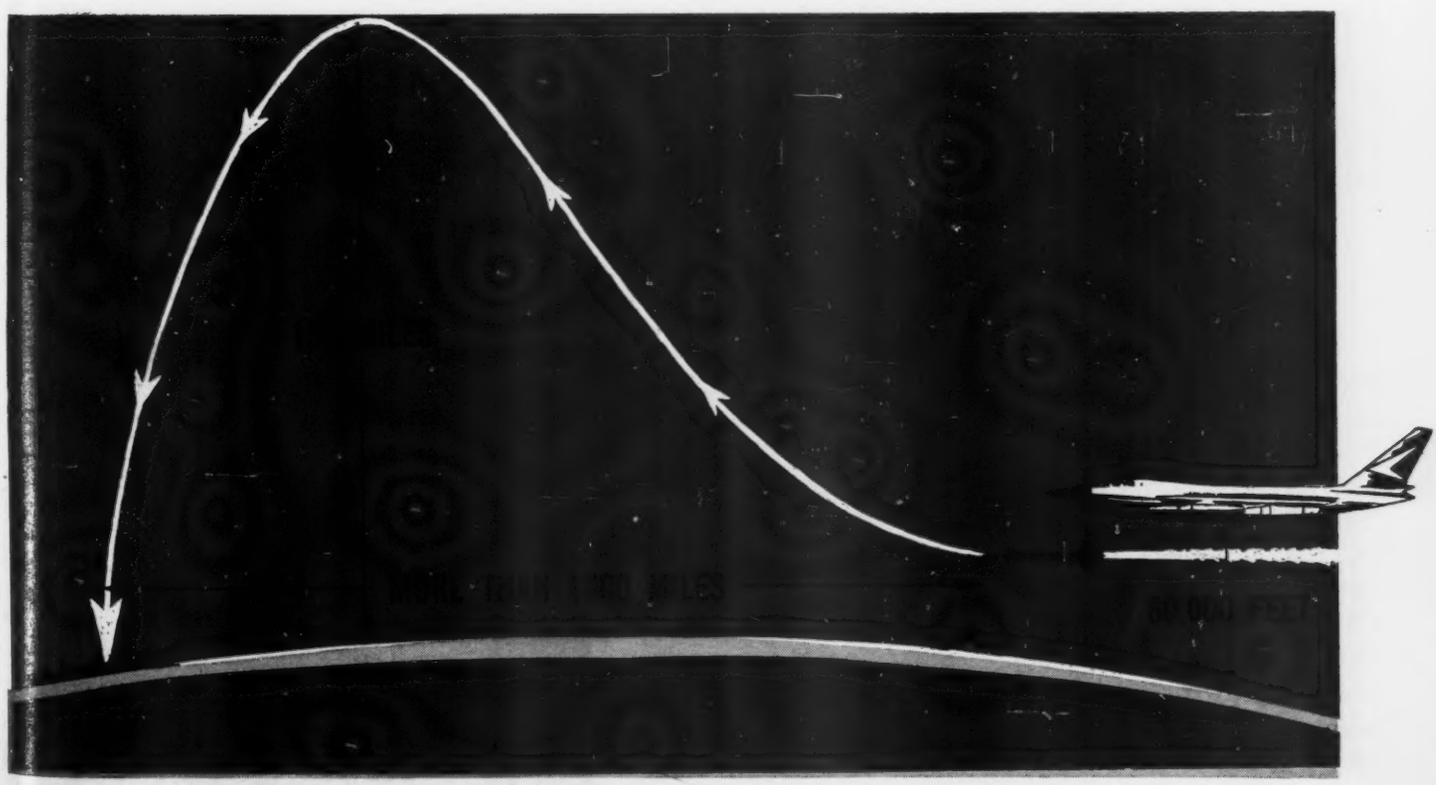
• **ALBM will not require major modifications of manned bomber systems already under development.** This is a bonus on top of the extended life it can give to existing manned aircraft. The system can be operational before the advent of North American's B-70 chemical bomber with Mach 3 capability or the nuclear-powered airplane with its huge advantage of unlimited range. These platforms, particularly the latter, are the aircraft Gen. Thomas D. White, USAF Chief of Staff, had in mind when he anticipated a "constant patrol of the free world skies" and in recent months spurred work on the CAMAL (Continuous Airborne Missile Alert) project, on which USAF can base an operational requirement for a nuclear-powered aircraft. In this sense, ALBM is related to CAMAL.

In the early days it would have all the requirements of the present system for air-to-air refueling and make use of a base complex for this kind of in-flight support. When the nuclear airplane is a reality the application will increase.

As Dr. Wohlstetter emphasizes, the CAMAL concept is an expensive one and there are operational experts in the Air Force who are skeptical of its economic practicality. This is one of several reasons why the United States has not put earlier and heavier emphasis on the nuclear airplane project.

The number of missile platforms is limited, regardless

(Continued on page 40)



Launching altitude in this chart assumes platform is B-58 supersonic aircraft. Missile launcher at lower altitudes, down to 500 feet, would sacrifice range but find it easier to evade enemy defense radar. Two rocket stages give push.

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of how they are propelled, and CAMAL is a concept that will require more airborne missile bases than SAC will have in its inventory. Yet a continuous airborne alert is the only way to get *maximum* deterrent ability out of ALBM and CAMAL. Again referring to Dr. Wohlstetter, he points out that our overseas bases are highly vulnerable, which is another way of saying they also are expensive because anything that is highly vulnerable—like a Cadillac parked with the key in the ignition—is apt to be lost.

Some day we may have to decide which is cheaper: the complex of overseas bases (including missile bases) or the continuous airborne missile alert. For the time being, USAF is not committed to CAMAL. Technical advances, both here and in Russia, along with political changes, will determine how close we can get to patrolling the world's skies. If a Soviet nuclear-powered airplane circles the world a few times before mid-1960—and this is a distinct possibility—it may become a lot easier for us to make up our minds about the kind of priority these projects should get.

Here is what the ALBM and CAMAL concepts have suggested to Maj. Gen. Donald J. Keirn, USAF Deputy Chief of Staff for Nuclear Weapons: "Imagine a fleet of 'enemy' high-speed aircraft continuously patrolling the airspace just outside our early-warning net, capable of air-launching a devastating missile attack against our hardened installations. Through a consideration of these capabilities, combined with those possessed by the intercontinental-range ballistic missile, the degree of possible future threat of surprise attack immediately becomes apparent. . . .

"An ideal airborne alert manned aircraft system must carry a large payload and remain on nomadic patrol for extended periods of time in various areas of the world. It must maintain continuous communication with appropriate headquarters and be capable of instantaneous reaction with air-launched missiles. When required, the system should be capable of following up the missile launching phase with a low-level high-speed penetration of the enemy's heartland in order to seek out and destroy hardened targets or targets whose locations are not sufficiently well known to permit attack by long-range missiles."

● **ALBM will have the best recall capability of any ballistic missile system.** The fact that a ballistic missile can't be stopped once it is on its way to the target is one of USAF's major worries. Dr. Wohlstetter points out that the decision to fire a missile is harder to make than the decision to dispatch a manned bomber. Under the "fail-safe" system a plane comes home unless it is told to hit the target. Dr. Wohlstetter can and does argue that the more dispersed our missile capability the more possible becomes accidental war. On the other hand, if this dispersal is in the air, on airborne missile bases, the biggest complication would appear to be the matter of communication. This admittedly can be bugged, and the foul-up might be disastrous. At the same time, the base is moving fast, it can change launch-points and targets almost at will. The base itself can be recalled. The pilot is a man with reasoning power, and the "fail-safe" system would have an application here that would not be possible on a submarine base, for example. Another fact of life that appeals to USAF's operational officers is that ALBM can be moved halfway or three-quarters of the way to the target and still be recalled. This simply is impossible with the ground-based ballistic missile.

● **ALBM will have application in limited war.** This is not an application that is emphasized by operational experts or even mentioned by Dr. Wohlstetter in his essay on deterrence. Strictly speaking, it is not part of deterrence when we are talking about a big thermonuclear war. At the same time, it is easy to see that a belligerent faction in some remote spot such as Korea, Formosa, Lebanon, or Suez might be intimidated if some ballistic missile bases could be moved within one or two thousand miles at supersonic speed to take up a patrol, ready to hurl a weapon at Mach 12 or Mach 15.

● **ALBM holds promise of more accuracy than ground-based ballistic missiles.** This is not a proven virtue at this point, but a missile launched from a base moving at Mach 2 or 3 has got a flying start, and can be expected to go in a pretty straight line. During the powered portion of its flight, ALBM will be corrected in its course by an inertial guidance system. The faster it goes during this part of the trajectory, the less time it has to get off course and require correction. A subsonic vehicle, it follows, will do more wandering—away from and then back to the required path.

● **ALBM is a logical outgrowth of progress already made in the art of air-launched missiles.** One of its ancestors was the Bell Rascal, which has been canceled. It was canceled by the march of technological progress, the very thing that has made ALBM possible. By today's standards Rascal was big and complex. North American's Hound Dog, designed for use on the B-52, still is far from operation. The project was put in high gear at a time when USAF was increasingly concerned about Soviet defensive capability and needed a tool to increase the probability that SAC's bombers could penetrate.

At the time Hound Dog was instigated serious thought was given to the ALBM approach, but it was not believed feasible at that time, and the B-52G—the first manned airplane described as a missile-launching platform—was designed to take a turbine-powered weapon. The advance to higher performance, particularly by the solid-fuel rockets now available, has led to ALBM as the newest generation.

In discussing the ALBM concept, USAF experts place continued emphasis on what it promises for the existing and still-growing fleet of B-52s. They see ahead a combination of the precision and flexibility of the manned bomber system with the super-performance of the unmanned ballistic missile. One important factor here is the range of the B-52. It is long-legged by any standard and will keep this quality for several years to come, outstepping both of its supersonic successors, the B-58 and B-70. These platforms will sacrifice range in order to maintain their high-speed performance for any appreciable length of time. From the standpoint of sheer numbers, the B-52 again will lead the field for a long time. Procurement of newer and faster bombers will not approach the wing strength of B-47s and B-52s.

It is unwise to look for miracles in new weapon systems to solve the problem of deterrence in the next few years. The ground-based ballistic missiles—the Thor, Atlas, Jupiter, Titan, and Minuteman—will be with us only if we can find a way to defend them. And the flexibility available to the enemy in both his offensive and defensive forces will make life as tough as possible for any systems we care to select.

This same kind of flexibility is essential for us and we must get it as economically as possible. The proven feasibility of ALBM, its quick availability, and the fact that it can extend the life of so much other equipment on the land and in the air, are getting serious consideration in the Pentagon.—END

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A Progress Report

WORLD CONGRESS OF FLIGHT

UNDER the general chairmanship of Edward P. (Ted) Curtis, planning and preparation for the first World Congress of Flight, to be held April 12 through April 19 in Las Vegas, Nev., are moving along steadily.

In his first public statement since assuming the post of general chairman for the event, Mr. Curtis referred to the World Congress as the "greatest cooperative effort undertaken to unite all major elements of aviation in a common cause."

"No one in any country," Mr. Curtis said, "has attempted to combine—in a single event and on such a large scale—conferences and forums, outdoor displays and indoor exhibits, with air and ground demonstrations—each dedicated to the advancement of aeronautics and astronautics, the twin sciences of flight. It is fitting that this huge effort should be undertaken first in America—the cradle of aviation."

Top names stud the World Congress of Flight committee which is serving with Mr. Curtis. They include: Joseph B. Burns, president, National Business Aircraft Association; Miss Jacqueline Cochran, president, Fédération Internationale Aeronautique; David R. Hull, president, Electronic Industries Association; Thomas G. Lanphier, Jr., president, National Aeronautic Association; Jerome F. Lederer, director, Flight Safety Foundation; Frank Pace, chairman, American Conference on NATO; Elwood R. Quesada, director, Federal Aviation Agency; Dr. Wayne O. Reed, deputy commissioner of education, US Office of Education, Department of Health, Education and Welfare; Peter J. Schenk, president, Air Force Association; Stuart G. Tipton, president, Air Transport Association; Dr. Theodore von Kármán, chairman, Advisory Group for Aeronautical Research and Development, NATO; and Gill Robb Wilson, chairman of the board of trustees and a former AFA president.

Air Force Association is sponsor of the World Congress of Flight, with the following organizations associated with AFA as cooperating agencies: Air Transport Association of America, Electronic Industries Association, Flight Safety Foundation, National Aeronautic Association, National Business Aircraft Association, and Space Education Foundation. At this writing more than 100 companies had agreed to exhibit in the indoor and outdoor display areas at Las Vegas. More than 200,000 square feet of space have been allocated to industrial exhibits, with approximately ninety percent of the indoor exhibit space already contracted for.

The selection of Las Vegas as the site for the World Congress of Flight was based on a combination of requirements and was made after a site committee carefully surveyed prospective locations. Requirements include conference facilities for a minimum of 5,000 persons; a modern exhibit hall; an outdoor display area near the conference hall; a civil airfield available for ground display and aerial demonstrations able to accommodate big jet transports; and for military aerial and firepower demonstrations—all these with adequate hotel facilities nearby. The site committee found that Las Vegas offered the best combination of facilities, with its new $5-million convention center and adjacent stadium area; with McCarran Field and its new 10,000-foot runway only minutes away; and nearby Nellis AFB with its gunnery range and covered grandstand for military aerial demonstrations. In addition, good flying weather, a must, can be expected.

At press time, some twenty-seven organizations in addition to the above are participating in the World Congress of Flight, either by scheduling meetings in or near Las Vegas, or by conducting activities in conjunction with the World Congress.

These include: Advanced Research Projects Agency, Department of Defense; Aero Medical Association; Aeronautical Training Society; Aircraft Service Association; Air Line Pilots Association, International; Air Materiel Command, USAF; Air Research and Development Command, USAF; Air Reserve Forces Policy Committee; Air Transport Association of America; Federal Aviation Agency; Fédération Aeronautique Internationale; Flight Safety Foundation; Industrial Associate Companies of the Air Force Association; Link Foundation; National Aeronautics and Space Administration; National Aeronautic Association; National Association of State Aviation Officials; National Business Aircraft Association; National Pilots Association; Reserve Officers Association; Scientific Advisory Board of the Air Force; Small Business Administration; Society of Experimental Test Pilots; Space Education Foundation; US Office of Education, Department of Health, Education and Welfare; University Aviation Association; and West Coast Electronic Manufacturers Association.

Mr. Curtis, executive vice president of Eastman Kodak Co., was recently awarded the Collier Trophy for the most outstanding aviation achievement of 1957, during which he served as special assistant to President Eisenhower for Aviation Facilities Planning. In that capacity, he was responsible for formulating the plan leading to the creation of the new Federal Aviation Agency.

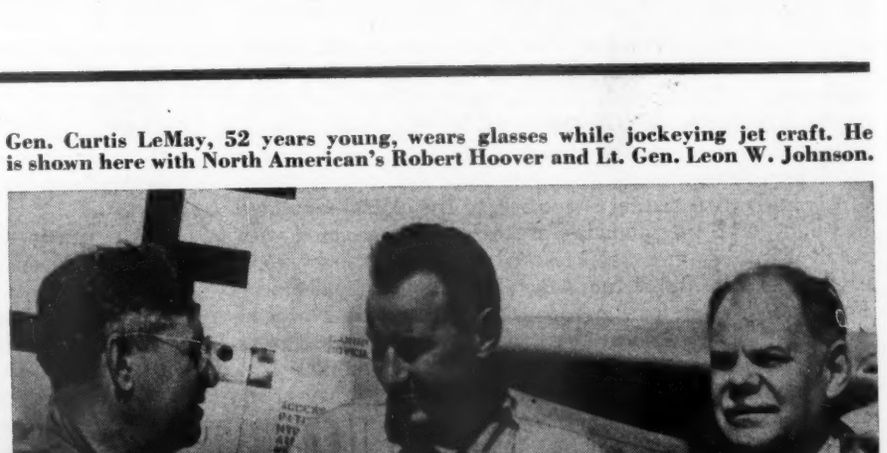
In his first progress report as general chairman of the first World Congress of Flight, Mr. Curtis said its program "will explore flight in terms of international security and human welfare; analyze the social, economic, political, and moral problems which accompany the progress of flight; present flight in its broadest concept as an instrument for the benefit of all mankind. The project is dedicated to the belief that greater world knowledge of aircraft, missiles, and spacecraft—in realistic perspective—will help bring the world closer to permanent peace."—END

USAF student pilots: How long is the flying "lifetime" before them under current operational, personnel conditions?

HOW USAF'S AGING TIGERS BEAT THE CLOCK

William Leavitt
ASSOCIATE EDITOR

Gen. Curtis LeMay, 52 years young, wears glasses while jockeying jet craft. He is shown here with North American's Robert Hoover and Lt. Gen. Leon W. Johnson.



The Air Force can't stop the aging process in its flyers, but it can try to keep its older personnel "younger" than they really are. The job takes constant vigilance

New at the business, youthful pilot is long on enthusiasm, tops physically. His contribution is vital but only beginning. It will grow with the years.

ALTHOUGH he is by no means typical, Air Force Vice Chief of Staff Gen. Curtis LeMay, who wears glasses while at the controls of a jet, is fifty-two years old. Ace test pilots such as USAF's Capt. Robert White, North American's Scotty Crossfield, and NASA's Joseph Walker, the trio who'll fly the X-15, are well into their thirties. Korean War jet ace Col. Francis S. Gabreski was past thirty when he won his victories over the best the Communists could put into the air, and there were others even older. The average age of SAC pilots is thirty-six, and there are some still at it who are in their forties.

These facts underscore the point that—unlike yesteryear—military aviation, whether it involves a tense strategic or tactical mission or the relative routine of a MATS flight, has become a skilled and demanding profession, with the accent on experience as the most significant factor in successful performance.

How to take advantage of that experience and at the same time pay attention to the problem of aging, the heart attacks, ulcers, and other breakdowns that lurk around the corner for all of us beyond the sturdy twenties, is a continuing Air Force problem.

Today, approximately forty-one percent of the cockpit jobs in the Air Force are held by men between thirty and thirty-nine. This percentage just about equals that of the twenty-five-to-twenty-nine group. Low budgets and personnel retention problems don't help the picture either. We have an aging Air Force (*see chart*).

Many of the men now flying have reached the age that would put a ball player on the bench; yet the airmen keep at it. *Years* and *experience* pile up, the last highly desirable, the first a problem for the airman, his commander, and the doctors.

The Air Force approach to this problem is constant vigilance aimed at keeping "older personnel" younger than they really are. This means maintaining the closest approximation possible of the physical perfection airmen had to show when they were accepted for flight training.

Of course, to do this exactly is impossible. You do what you can. An important part of the Air Force approach is what really amounts to *two* sets of standards for airmen; those for initial acceptance and those for the "old timers." As one Air Force doctor sums it up:

"As a man ages, he necessarily degrades physically. So, if he needs glasses, we don't take him off the job because he doesn't have 20-20 anymore. We try to give him the best pair of glasses we can get. They may well have to be glasses that won't steam up in an oxygen helmet. They may have to be contact lenses. They have to be as reliable as the man they're going to serve."

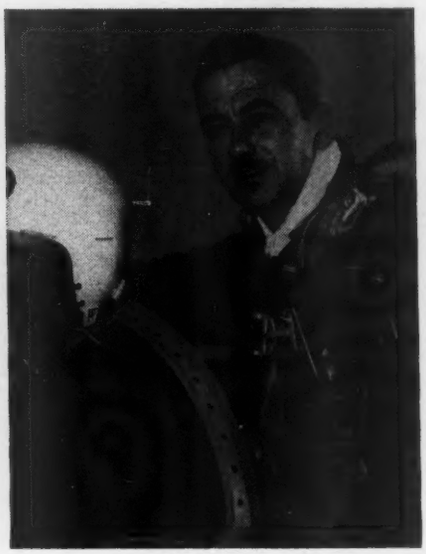
This kind of maintenance is increasing. All airmen now receive an annual stringent examination, with a required electrocardiogram for all personnel

(Continued on following page)

	AGE	PERCENTAGE
Young group 53%	24 and under	11%
	25 to 29	42%
Middle group 41%	30 to 34	17%
	35 to 39	24%
Older group 6%	40 and over	6%

Age Categories of USAF Cockpit Personnel

This table tells the story of an aging Air Force. The 30-to-39 age group approximately equals the 25-to-29 group in size. Each category makes definite, important contributions. The Air Force effort is to keep flyers in the middle and older groups at the peak of physical and psychological conditioning.



Left to right, Korean War aces, Col. Francis Gabreski, Lt. Col. Vermont Garrison, Capt. Robert Love, all "older personnel" by usual standards. Gabreski was 31, Garrison 35, Love 33, when the historic police action started in 1950.

over forty. Soon the Air Force will have a program operating under which *all* flying personnel will receive electrocardiograms on an Air Force-wide basis every five years.

The regulations require that flying personnel be examined by medical officers trained in aviation medicine. This is because the problems of pilot health are best understood by men themselves who fly.

The maintenance effort goes beyond the routine medical areas. Airmen are encouraged to talk candidly to their flight surgeons about "how they feel." The effort is to create a personal relationship between the flight surgeon and the airman, so that the developing nearsightedness or the "trouble with my sinuses" doesn't have to wait for the annual examination.

When this maintenance program is balanced against the perfection standards for flight-training candidates, the sum is an inventory of men in better shape than the general population of the same age group. The payoff in the maintenance program is illustrated in figures on such a vital item as heart disease. According to the office of the Air Force Surgeon General, the incidence of heart disease is lower for the up-to-forty group of aircrew personnel than in the general population.

There's another interesting aspect to the problem of heart disease that's worth mentioning: In some ways, a desk job in the Pentagon can be more hazardous than sky work. More often than is pleasant to note, personnel transferred from, say, SAC to a job in the Pentagon will fall prey to heart or stomach ailments that probably would not have come along in their old assignments. This, according to Air Force medical people, is probably due to the kinds of stresses and frustrations that a "chairbound" officer must suffer. The physical outlay of energy may be smaller at a desk, but in many ways the problems are more complicated. In the air the stakes are higher, but you do the same job with the same accumulated skill for longer periods of time.

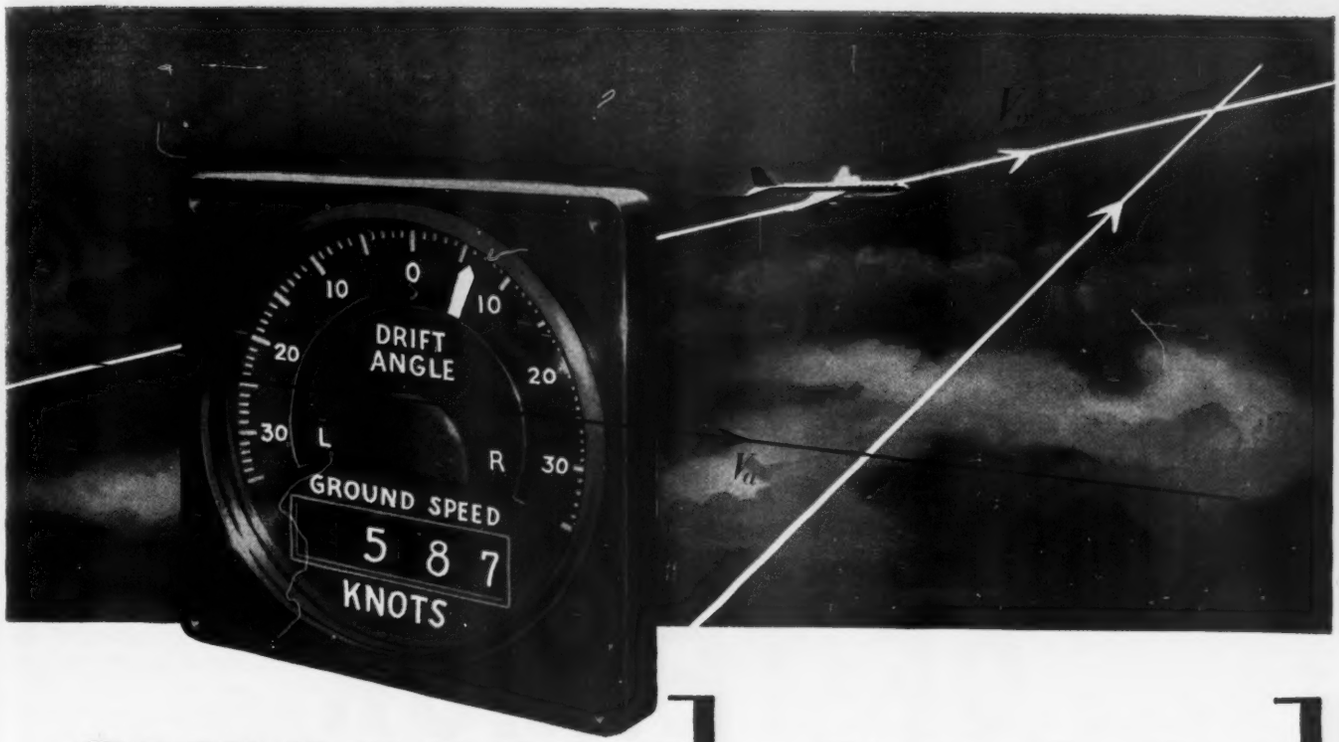
What are some of the tradeoffs among the younger, middle, and older groups of flyers—the man between twenty and twenty-five, the man between twenty-five and thirty, and the one in the thirty-to-forty group? A few generalizations are possible.

- The man twenty-five or younger is newly out of flying training. He is enthusiastic, and to him his new business is part adventure. Unless he very rapidly accumulates much experience, it will be a matter of some years before flying becomes a "trade" to him. Although he loves flying, he still may not have made the final decision to make the Air Force his career. He is probably married, may have a child. He looks at his older commander with mixed emotions, part awe, part natural wish to be running his own show. His contribution is great, but it is only beginning. He is in top physical condition.

- The man in the next group—from twenty-five to twenty-nine, by way of contrast, has probably made the important decision for a permanent career. And he has attained much of the experience and maturity that subtly transforms his feeling about flying from "adventure" to "trade." He is close in time to the top physical condition that qualified him for flight training at the outset. He and his family have gotten used to the Air Force way of life, accustomed to the moving around and the adjustments. He is looked up to by the younger men and looks up to the older ones.

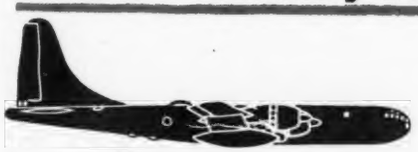
- His confrere from thirty to forty is the "old-timer." The gray hairs have sprouted, or the hairline has receded. Family problems may be bigger. He's been at it a long time. He's seen comrades go down in combat or in accidents. Every once in a while, he may wonder if he's had enough. But he is a longtime pro; he has seen the consequences of overconfidence or error. Some experts point out, too, that respect for the aircraft increases with the age and experience of the pilot. His total experience is priceless in dollars; the coin is the country's security.

Each of the age groups has a definite, important contribution to make to the Air Force's global mission. The perfect physical condition of the newest and youngest men, the developing maturity of the middle group, the "old-pro" experience of the oldest men—all add up to the best force available under the present personnel and budget ground rules. As to the perfect age, if the Air Force could wave a wand, it would probably keep its flyers permanently between twenty-five and thirty. But time is inexorable. Everyone gets to be thirty, thirty-five, forty—and you don't throw away experience. Instead, you keep your "old" people young, using every tool of medicine and psychology.—END



ground speed & drift angle

ANY TIME, ANYWHERE, ANY WEATHER



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THE DELICATE BALANCE OF TERROR

There is a theory, growing in popularity, that it doesn't really matter if the Soviet Union outstrips us in the arms race so long as we maintain the ability to lay waste their cities. The proponents of this "minimum deterrence" theory say that "you can't blow a man's brains out twice," that if we can devastate the Soviet Union with 500 H-bombs it matters little whether the Soviets are able to hit us with 5,000. Minimum deterrence is popular because it is a facile way of keeping defense expenditures down. It also appeals to those who, because of tradition, vested interests, or ignorance, would like to see funds diverted from our strategic striking capability to other far less vital military missions.

That this is wishful thinking of the worst kind is made abundantly clear in the thoughtful, scholarly discussion of deterrence which appears on the following pages. The author, Dr. Albert J. Wohlstetter, is Associate Director of Projects for the RAND Corporation, the private, nonprofit corporation which conducts studies under contract to the Air Force. For the past several years, Dr. Wohlstetter has directed RAND's research studies in the area of strategic airpower and recently served as adviser to the United States delegation at the Geneva Conference on reducing the risk of surprise attack.

As he cogently points out, deterrence has been badly mangled in meaning over the years, both by its proponents and by its detractors. When this nation had a monopoly on nuclear weapons and their intercontinental delivery systems, it was comparatively easy to understand. Our ability to devastate Soviet targets almost at will inhibited Red aggression. It was a simple "one-move-and-I'll-shoot" situation. But the Russians have had the hydrogen bomb for more than five years, and all indications are that their delivery systems are becoming both more sophisticated and more numerous at a faster pace than our own. If this ratio continues, at some point they will be able to punish SAC, in a surprise attack, to the extent that the remnants of SAC will not be able to play a decisive role no matter how many Soviets they may kill in a suicidal thrust of revenge.

This is why deterrent strength, in a changing world, must be overwhelming—not marginal. It must be dynamic, not static. It must be strong enough to absorb the first blow—and still strike back decisively. Otherwise there is no deterrence. As Dr. Wohlstetter puts it, we cannot deter an attack which we cannot survive. We cannot predicate our deterrent capability on what we have, but on what we would have left.

How much we would have left depends on an intricate relationship of many factors which Dr. Wohlstetter calls "the delicate balance of terror."

In all candor, while we agree wholeheartedly with his basic thesis, we must take issue with him when he discusses conventional capabilities for limited wars. Under present fiscal ground rules there is absolutely no hope for obtaining any kind of a conventional capability except at the expense of the strategic deterrence. And while other capabilities in certain circumstances may appear desirable, the strategic deterrent capability is essential. We cannot allow it to be eroded or compromised without taking an unacceptable risk with our survival.

—JOHN F. LOOSBROCK, *Editor*

Albert J. Wohlstetter

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THE first shock administered by the Soviet launching of Sputnik has almost dissipated. The flurry of statements and investigations and improvised responses has died down, leaving a small residue: a slight increase in the schedule of bomber and ballistic missile production, with a resulting small increment in our defense expenditures for the current fiscal year; a considerable enthusiasm for space travel; and some stirrings of interest in the teaching of mathematics and physics in the secondary schools. Western defense policy has almost returned to the level of activity and the emphasis suited to the basic assumptions which were controlling before Sputnik.

One of the most important of these assumptions—that a general thermonuclear war is extremely unlikely—is held in common by most of the critics of our defense policy as well as by its proponents. Because of its crucial role in the Western strategy of defense, I should like to examine the stability of the thermonuclear balance which, it is generally supposed, would make aggression irrational or even insane. The balance, I believe, is in fact precarious, and this fact has critical implications for policy. Deterrence in the 1960s is neither assured nor impossible but will be the product of sustained intelligent effort and hard choices, responsibly made. As a major illustration important both for defense and foreign policy, I shall treat the particularly stringent conditions for deterrence which affect forces based close to the enemy, whether they are US forces or those of our allies, under single or joint control. I shall comment also on the inadequacy as well as the necessity of deterrence, on the accidental outbreak of war, and on disarmament.

THE PRESUMED AUTOMATIC BALANCE

I emphasize that requirements for deterrence are stringent. We have heard so much about the atomic stalemate and the receding probability of war which it has produced that this may strike the reader as something of an exaggeration. Is deterrence a necessary consequence of both sides having a nuclear delivery capability, and is all-out war nearly obsolete? Is mutual extinction the only outcome of a general war? This belief, frequently expressed by references to Mr. Oppenheimer's simile of the two scorpions in a bottle, is perhaps the prevalent one. It is held by a very eminent and diverse group of people—in England by Sir Winston Churchill, P. M. S. Blackett, Sir John Slessor, Admiral Buzzard, and many others; in France by such figures as Raymond Aron, General Gallois, and General Gazin; in this country by the titular heads of both parties as well as almost all writers on military and foreign affairs, by both Henry Kissinger and his critic, James E. King, Jr., and by George Kennan as well as Dean Acheson. Mr. Kennan refers to American concern about surprise attack as simply obsessive; and many people have drawn the consequence of the stalemate as has Blackett, who states: "If it is, in fact, true, as most current opinion holds, that strategic airpower has abolished global war, then an urgent problem for the West is to assess how little effort must be put into it to keep global war abolished." If peace were founded firmly on mutual terror, and mutual terror on symmetrical nuclear capabilities, this would be, as Churchill has said, "a melancholy paradox"; nonetheless a most comforting one.

Deterrence, however, is not automatic. While feasible, it will be much harder to achieve in the 1960s than is generally believed. One of the most disturbing features of current opinion is the underestimation of this difficulty. This is due partly to a misconstruction of the technological race as a problem in matching striking forces, partly to a wishful analysis of the Soviet ability to strike first.

Since Sputnik, the United States has made several moves to assure the world (that is, the enemy, but more especially our allies and ourselves) that we will match or overmatch Soviet technology and, specifically, Soviet offense technology. We have, for example, accelerated the bomber and ballistic missile programs; in particular, the intermediate-range ballistic missiles. The problem has been conceived as more or better bombers—or rockets, or Sputniks, or engineers. This has meant confusing deterrence with matching or exceeding the enemy's ability to strike first. Matching weapons, however, misconstrues the nature of the technological race. Not, as is frequently said, because only a few bombs owned by the defender can make aggression fruitless, but because even many might not. One outmoded A-bomb dropped from an obsolete bomber might destroy a great many supersonic jets and ballistic missiles. To deter an attack means being able to strike back in spite of it. It means, in other words, a capability to strike second. In the last year or two there has been a growing awareness of the importance of the distinction between a "strike-first" and a "strike-second" capability, but little, if any, recognition of the implications of this distinction for the balance of terror theory.

Where the published writings have not simply underestimated Soviet capabilities and the advantages of a first strike, they have in general placed artificial constraints on the Soviet use of the capabilities attributed to them. They assume, for example, that the enemy will attack in mass over the Arctic through our Distant Early Warning Line, with bombers refueled over Canada—all resulting in plenty of warning. Most hopefully, it is sometimes assumed that such attacks will be preceded by days of visible preparations for moving ground troops. Such assumptions suggest that the Soviet leaders will be rather bumbling or, better, cooperative. However attractive it may be for us to narrow Soviet alternatives to these, they would be low in the order of preference of any reasonable Russians planning war.

THE QUANTITATIVE NATURE OF THE PROBLEM AND THE UNCERTAINTIES

In treating Soviet strategies it is important to consider Soviet rather than Western advantage and to consider the strategy of both sides quantitatively. The effectiveness of

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our own choices will depend on a most complex numerical interaction of Soviet and Western plans. Unfortunately, both the privileged and unprivileged information on these matters is precarious. As a result, competent people have been led into critical error in evaluating the prospects for deterrence. Western journalists have greatly overestimated the difficulties of a Soviet surprise attack with thermonuclear weapons and vastly underestimated the complexity of the Western problem of retaliation.

One intelligent commentator, Richard Rovere, recently expressed the common view: "If the Russians had ten thousand warheads and a missile for each, and we had ten hydrogen bombs and ten obsolete bombers . . . aggression would still be a folly that would appeal only to an insane adventurer." Mr. Rovere's example is plausible because it assumes implicitly that the defender's hydrogen bombs will with certainty be visited on the aggressor; then the damage done by the ten bombs seems terrible enough for deterrence, and any more would be simply redundant. This is the basis for the common view. The example raises questions, even assuming the delivery of the ten weapons. For instance, the targets aimed at in retaliation might be sheltered and a quite modest civil defense could hold within tolerable limits the damage done to such city targets by ten delivered bombs. But the essential point is that the weapons would not be very likely to reach their targets. Even if the bombers were dispersed at ten different points, and protected by shelters so blast resistant as to stand up anywhere outside the lip of the bomber crater—even inside the fireball itself—the chances of one of these bombers surviving the huge attack directed at it would be on the order of one in a million. (This calculation takes into account the unreliability and inaccuracy of the missile.) And the damage done by the small minority of these ten planes that might be in the air at the time of the attack, armed and ready to run the gantlet of an alert air defense system, if not zero, would be very small indeed compared to damage that Russia has suffered in the past. For Mr. Rovere, like many other writers on this subject, numerical superiority is not important at all.

For Joseph Alsop, on the other hand, it is important, but the superiority is on our side. Mr. Alsop recently enunciated as one of the four rules of nuclear war: "The aggressor's problem is astronomically difficult; and the aggressor requires an overwhelming superiority of force." [A footnote points out that since these lines appeared in the May '58 *Encounter,* "Mr. Alsop's views have altered."] There are, he believes, no fewer than 400 SAC bases in the NATO nations alone and many more elsewhere, all of which would have to be attacked in a very short space of time. The "thousands of coordinated air sorties and/or missile firings," he concludes, are not feasible. Mr. Alsop's argument is numerical and has the virtue of demonstrating that at least the relative numbers are important. But the numbers he uses are very wide of the mark. He overestimates the number of such bases by a factor of more than ten, and in any case, missile firings on the scale of a thousand or more involve costs that are by no means out of proportion, given the strategic budgets of the great powers. Whether or not thousands are needed depends on the yield and the accuracy of the enemy missiles, something about which it would be a great mistake for us to display confidence.

Perhaps the first step in dispelling the nearly universal optimism about the stability of deterrence would be to recognize the difficulties in analyzing the uncertainties and interactions between our own wide range of choices and the moves open to the Soviets. On our side we must consider an enormous variety of strategic weapons which might compose our force, and for each of these several alternative methods of basing and operation. These are the choices that determine whether a weapon system will have any genuine capability in the realistic circumstances of a war. Besides the B-47E and the B-52 bombers which are in the United States strategic force now, alternatives will include the B-52G (a longer-range version of the B-52); the Mach 2 B-58A bomber and a "growth" version of it; the Mach 3 B-70 bomber; a nuclear-powered bomber possibly carrying long-range air-to-surface missiles; the Dyna-Soar, a manned glide rocket; the Thor and the Jupiter, liquid-fueled intermediate-range ballistic missiles; the Snark intercontinental cruise missile; the Atlas and the Titan intercontinental ballistic missiles; the submarine-launched Polaris and Atlantis rockets; and Minuteman, one potential solid-fueled successor to the Thor and Titan; possibly unmanned bombardment satellites; and many others which are not yet gleams in anyone's eyes and some that are just that.

The difficulty of describing in a brief article the best mixture of weapons for the long-term future beginning in 1960, their base requirements, their potentiality for stabilizing or upsetting the balance among the great powers, and their implications for the alliance, is not just a matter of space or the constraint of security. The difficulty, in fact, stems from some rather basic insecurities. These matters are wildly uncertain; we are talking about weapons and vehicles that are some time off and, even if the precise performances currently hoped for and claimed by contractors were in the public domain, it would be a good idea to doubt them.

Recently some of my colleagues picked their way through the graveyard of early claims about various missiles and aircraft: their dates of availability, costs, and performance. These claims are seldom revisited or talked about: *de mortuis nil nisi bonum.* The errors were large and almost always in one direction. And the less we knew, the more hopeful we were. Accordingly, the missiles benefited in particular. For example, the estimated cost of one missile increased by a factor of over fifty—from about $35,000 in 1949 to some $2 million in 1957. This uncertainty is critical. Some but not all of the systems listed can be chosen and the problem of choice is essentially quantitative. The complexities of the problem, if they were more widely understood, would discourage the oracular confidence of writers on the subject of deterrence.

Some of the complexities can be suggested by referring to the successive obstacles to be hurdled by any system providing a capability to strike second, that is, to strike back. Such deterrent systems must have (a) a stable, "steady-state" peacetime operation within feasible budgets (besides the logistic and operational costs there are, for example, problems of false alarms and accidents). They must have also the ability (b) to survive enemy attacks, (c) to make and communicate the decision to retaliate, (d) to reach enemy territory with fuel enough to complete their mission, (e) to penetrate enemy active defenses, that is, fighters and surface-to-air missiles, and (f) to destroy the target in spite of any "passive" civil defense in the form of dispersal or protective construction or evacuation of the target itself.

Within limits the enemy is free to use his offensive and defensive forces so as to exploit the weaknesses of each of our systems. He will also be free, within limits, in the 1960s to choose that composition of forces which will make life as difficult as possible for the various systems we might select. It would be quite wrong to assume that we have the same degree of flexibility or that the uncertainties I have described affect a totalitarian aggressor and the party attacked equally. A totalitarian country can

preserve secrecy about the capabilities and disposition of his forces very much better than a Western democracy. And the aggressor has, among other enormous advantages of the first strike, the ability to weigh continually our performance at each of the six barriers and to choose that precise time and circumstance for attack which will reduce uncertainty. It is important not to confuse our uncertainty with his. Strangely enough, some military commentators have not made this distinction and have founded their certainty of deterrence on the fact simply that there are uncertainties.

Unwarranted optimism is displayed not only in the writings of journalists but in the more analytic writings of professionals. The recent writings of Gen. Pierre N. Gallois parallel rather closely Mr. Alsop's faulty numerical proof that surprise attack is astronomically difficult—except that Gallois' "simple arithmetic," to borrow his own phrase, turns essentially on some assumptions which are at once inexplicit and extremely optimistic with respect to the blast resistance of dispersed missile sites subjected to attack from relatively close range. Mr. Blackett's recent book, *Atomic Weapons and East-West Relations,* illustrates the hazards confronting a most able analyst in dealing with the piecemeal information available to the general public. Mr. Blackett, a Nobel prize-winning physicist with wartime experience in military operations research, lucidly summarized the public information available when he was writing in 1956 on weapons for all-out war. But much of his analysis was based on the assumption that H-bombs could not be made small enough to be carried in an intercontinental missile. It is now widely known that intercontinental ballistic missiles will have hydrogen warheads, and this fact, a secret at the time, invalidates Mr. Blackett's calculations and, I might say, much of his optimism on the stability of the balance of terror. In sum, one of the serious obstacles to any widespread rational judgment on these matters of high policy is that critical elements of the problem *have* to be protected by secrecy. However, some of the principal conclusions about deterrence in the early 1960s can be fairly firmly based, and based on public information.

THE DELICACY OF THE BALANCE OF TERROR

The most important conclusion is that we must expect a vast increase in the weight of attack which the Soviets can deliver with little warning, and the growth of a significant Russian capability for an essentially warningless attack. As a result, strategic deterrence, while feasible, will be extremely difficult to achieve, and at critical junctures in the 1960s we may not have the power to deter attack. Whether we have it or not will depend on some difficult strategic choices as to the future composition of the deterrent forces as well as hard choices on its basing, operations, and defense.

Manned bombers will continue to make up the predominant part of our striking force in the early 1960s. None of the popular remedies for their defense will suffice—not, for example, mere increase of alertness (which will be offset by the Soviet's increasing capability for attack without significant warning), nor simple dispersal or sheltering alone or mobility taken by itself, nor a mere piling up of interceptors and defense missiles around SAC bases. Especially extravagant expectations have been placed on the airborne alert—an extreme form of defense by mobility. The impression is rather widespread that one-third of the SAC bombers are in the air and ready for combat at all times. This belief is belied by the public record. According to the Symington Committee hearings in 1956, our bombers averaged thirty-one hours of flying per month, which is about four percent of the average 732-hour month. An Air Force representative expressed the hope that within a couple of years, with an increase in the ratio of crews to aircraft, the bombers would reach forty-five hours of flight per month—which is six percent. This four to six percent of the force includes bombers partially fueled and without bombs. It is, moreover, only an average, admitting variance down as well as up. Some increase in the number of armed bombers aloft is to be expected. However, for the current generation of bombers, which have been designed for speed and range rather than endurance, a continuous air patrol for one-third of the force would be extremely expensive.

On the other hand, it would be unwise to look for miracles in the new weapon systems, which by the mid-1960s may constitute a considerable portion of the United States force. After the Thor, Atlas, and Titan there are a number of promising developments. The solid-fueled rockets, Minuteman and Polaris, promise in particular to be extremely significant components of the deterrent force. Today they are being touted as making the problem of deterrence easy to solve and, in fact, guaranteeing its solution. But none of the new developments in vehicles is likely to do that. For the complex job of deterrence, they all have limitations. The unvaryingly immoderate claims for each new weapon system should make us wary of the latest "technological breakthroughs." Only a very short time ago the ballistic missile itself was supposed to be intrinsically invulnerable on the ground. It is now more generally understood that its survival is likely to depend on a variety of choices in its defense.

It is hard to talk with confidence about the mid and late 1960s. A systematic study of an optimal or a good deterrent force which considered all the major factors affecting choice and dealt adequately with the uncertainties would be a formidable task. In lieu of this, I shall mention briefly why none of the many systems available or projected dominates the others in any obvious way. My comments will take the form of a swift run-through of the characteristic advantages and disadvantages of various strategic systems at each of the six successive hurdles mentioned earlier.

The first hurdle to be surmounted is the attainment of a stable, steady-state peacetime operation. Systems which depend for their survival on extreme decentralization of controls, as may be the case with large-scale dispersal and some of the mobile weapons, raise problems of accidents and over a long period of peacetime operation this leads in turn to serious political problems. Systems relying on extensive movement by land, perhaps by truck caravan, are an obvious example; the introduction of these on European roads, as is sometimes suggested, would raise grave questions for the governments of some of our allies. Any extensive increase in the armed air alert will increase the hazard of accident and intensify the concern already expressed among our allies. Some of the proposals for bombardment satellites may involve such hazards of unintended bomb release as to make them out of the question.

The cost to buy and operate various weapon systems must be seriously considered. Some systems buy their ability to negotiate a given hurdle—say, surviving the enemy attack—only at prohibitive cost. Then the number

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that can be bought out of a given budget will be small, and this will affect the relative performance of competing systems at various other hurdles, for example penetrating enemy defenses. Some of the relevant cost comparisons, then, are between competing systems; others concern the extra costs to the enemy by canceling an additional expenditure of our own. For example, some dispersal is essential, though usually it is expensive; if the dispersed bases are within a warning net, dispersal can help to provide warning against some sorts of attack, since it forces the attacker to increase the size of his raid and so makes it more liable to detection as well as somewhat harder to coordinate. But as the sole or principal defense of our offensive force, dispersal has only a brief useful life and can be justified financially only up to a point. For against our costs of construction, maintenance and operation of an additional base must be set the enemy's much lower costs of delivering one extra weapon. And, in general, any feasible degree of dispersal leaves a considerable concentration of value at a single target point. For example, a squadron of heavy bombers costing, with their associated tankers and penetration aids, perhaps $500 million over five years, might be eliminated, if it were otherwise unprotected, by an enemy intercontinental ballistic missile costing perhaps $16 million. After making allowance for the unreliability and inaccuracy of the missile, this means a ratio of some ten for one or better. To achieve safety by *brute* numbers in so unfavorable a competition is not likely to be viable economically or politically. However, a viable peacetime operation is only the first hurdle to be surmounted.

At the second hurdle—surviving the enemy offense—ground-alert systems placed deep within a warning net look good against a manned bomber attack, much less good against intercontinental ballistic missiles, and not good at all against ballistic missiles launched from the sea. In the last case, systems such as the Minuteman, which may be sheltered and dispersed as well as alert, would do well. Systems involving launching platforms which are mobile and concealed, such as Polaris submarines, have particular advantage for surviving an enemy offense.

However, there is a third hurdle to be surmounted—namely that of making the decision to retaliate and communicating it. Here, Polaris, the combat air patrol of B-52s, and, in fact, all of the mobile platforms—under water, on the surface, in the air, and above the air—have severe problems. Long-distance communication may be jammed and, most important, communication centers may be destroyed.

At the fourth hurdle—ability to reach enemy territory with fuel enough to complete the mission—several of our short-legged systems have operational problems such as coordination with tankers and using bases close to the enemy. For a good many years to come, up to the mid-1960s in fact, this will be a formidable hurdle for the greater part of our deterrent force. The next section of this article deals with this problem at some length.

The fifth hurdle is the aggressor's long-range interceptors and close-in missile defenses. To get past these might require large numbers of planes and missiles. (If the high cost of overcoming an earlier obstacle—using extreme dispersal or airborne alert or the like—limits the number of planes or missiles bought, our capability is likely to be penalized disproportionately here.) Or getting through may involve carrying heavy loads of radar decoys, electronic jammers, and other aids to defense penetration. For example, vehicles like Minuteman and Polaris, which were made small to facilitate dispersal or mobility, may suffer here because they can carry fewer penetration aids.

At the final hurdle—destroying the target in spite of the passive defenses that may protect it—low-payload and low-accuracy systems, such as Minuteman and Polaris, may be frustrated by blast-resistant shelters. For example, five half-megaton weapons with an average inaccuracy of two miles might be expected to destroy half the population of a city of 900,000, spread over forty square miles, provided the inhabitants are without shelters. But if they are provided with shelters capable of resisting over-pressures of 100 pounds per square inch, approximately sixty such weapons would be required; and deep rock shelters might force the total up to over a thousand.

Prizes for a retaliatory capability are not distributed for getting over one of these jumps. A system must get over all six. I hope these illustrations will suggest that assuring ourselves the power to strike back after a massive thermonuclear surprise attack is by no means as automatic as is widely believed.

In counteracting the general optimism as to the ease and, in fact, the inevitability of deterrence, I should like to avoid creating the extreme opposite impression. Deterrence demands hard, continuing, intelligent work, but it can be achieved. The job of deterring rational attack by guaranteeing great damage to an aggressor is, for example, very much less difficult than erecting a nearly airtight defense of cities in the face of full-scale thermonuclear surprise attack. Protecting manned bombers and missiles is much easier because they may be dispersed, sheltered, or kept mobile, and they can respond to warning with greater speed. Mixtures of these and other defenses with complementary strengths can preserve a powerful remainder after attack. Obviously not all our bombers and missiles need to survive in order to fulfill their mission. To preserve the majority of our cities intact in the face of surprise attack is immensely more difficult, if not impossible. (This does not mean that the aggressor has the same problem in preserving his cities from retaliation by a poorly protected, badly damaged force. And it does not mean that *we* should not do more to limit the extent of the catastrophe to our cities in case deterrence fails. I believe we should.) Deterrence, however, provided we work at it, is feasible; and, what is more, it is a crucial objective of national policy.

What can be said, then, as to whether general war is unlikely? Would not a general thermonuclear war mean "extinction" for the aggressor as well as the defender? "Extinction" is a state that badly needs analysis. Russian casualties in World War II were more than 20,000,000. Yet Russia recovered extremely well from this catastrophe. There are several quite plausible circumstances in the future when the Russians might be quite confident of being able to limit damage to considerably less than this number—if they make sensible strategic choices and we do not. On the other hand, the risks of not striking might at some juncture appear very great to the Soviets, involving, for example, disastrous defeat in peripheral war, loss of key satellites with danger of revolt spreading—possibly to Russia itself—or fear of an attack by ourselves. Then, striking first, by surprise, would be the sensible choice for them, and from their point of view the smaller risk.

It should be clear that it is not fruitful to talk about the likelihood of general war without specifying the range of alternatives that are pressing on the aggressor and the strategic postures of both the Soviet bloc and the West. Deterrence is a matter of comparative risks. The balance is not automatic. First, since thermonuclear weapons give

an enormous advantage to the aggressor, it takes great ingenuity and realism at any given level of nuclear technology to devise a stable equilibrium. And second, this technology itself is changing with fantastic speed. Deterrence will require an urgent and continuing effort.

THE USES AND RISKS OF BASES CLOSE TO THE SOVIETS

It may now be useful to focus attention on the special problems of deterrent forces close to the Soviet Union. First, overseas areas have played an important role in the past and have a continuing though less certain role today. Second, the recent acceleration of production of intermediate-range ballistic missiles and the negotiation of agreements with various NATO powers for their basing and operation have given our overseas bases a renewed importance in deterring attack on the United States—or so it would appear at first blush. Third, an analysis can throw some light on the problems faced by our allies in developing an independent ability to deter all-out attack on themselves, and in this way it can clarify the much agitated question of nuclear sharing. Finally, overseas bases affect in many critical ways, political and economic as well as military, the status of the alliance.

At the end of the last decade overseas bases appeared to be an advantageous means of achieving the radius extension needed by our short-legged bombers, of permitting them to use several axes of attack, and of increasing the number of sorties possible in the course of an extended campaign. With the growth of our own thermonuclear stockpile, it became apparent that a long campaign involving many re-uses of a large proportion of our bombers was not likely to be necessary. With the growth of a Russian nuclear-delivery capability, it became clear that this was most unlikely to be feasible.

Our overseas bases now have the disadvantage of high vulnerability. Because they are closer than the United States to the Soviet Union, they are subject to a vastly greater attack by a larger variety as well as number of vehicles. With given resources the Soviets might deliver on nearby bases a freight of bombs with something like fifty to 100 times the yield that they could muster at intercontinental range. Missile accuracy would more than double. Because there is not much space for obtaining warning—in any case, there are no deep-warning radar nets—and, since most of our overseas bases are close to deep water from which submarines might launch missiles, the warning problem is very much more severe than for bases in the interior of the United States.

As a result, early in the 1950s the US Air Force decided to recall many of our bombers to the continental United States and to use the overseas bases chiefly for refueling, particularly post-strike ground refueling. This reduced drastically the vulnerability of US bombers and at the same time retained many of the advantages of overseas operation. For some years now SAC has been reducing the number of aircraft usually deployed overseas. The purpose is to reduce vulnerability and has little to do with any increasing radius of SAC aircraft. The early B-52 radius is roughly that of the B-36; the B-47, roughly that of the B-50 or B-29. In fact the radius limitation and therefore the basing requirements we have discussed will not change substantially for some time to come. We can talk with comparative confidence here, because the US strategic force is itself largely determined for this period. Such a force changes more slowly than is generally realized. The vast majority of the force will consist of manned bombers, and most of these will be of medium range. *Some* US bombers will be able to reach *some* targets from *some* US bases within the forty-nine states without landing on the way back. On the other hand, some bomber-target combinations are not feasible without pretarget landing (and are therefore doubtful). The Atlas, Titan, and Polaris rockets, when available, can of course do without overseas bases (though the proportion of Polaris submarines kept at sea can be made larger by the use of submarine tenders based overseas). But even with the projected force of aerial tankers, the greater part of our force, which will be manned bombers, cannot be used at all in attacks on the Soviet Union without at least some use of overseas areas.

What of the bases for Thor and Jupiter, our first intermediate-range ballistic missiles? These have to be close to the enemy, and they must, of course, be operating bases, not merely refueling stations. The Thors and Jupiters will be continuously in range of an enormous Soviet potential for surprise attack. These installations therefore reopen, in a most acute form, some of the serious questions of ground vulnerability that were raised about six years ago in connection with our overseas bomber bases. The decision to station the Thor and Jupiter missiles overseas has been our principal public response to the Russian advances in rocketry, and perhaps our most plausible response. Because it involves our ballistic missiles, it appears directly to answer the Russian rockets. Because it involves using European bases, it appears to make up for the range superiority of the Russian intercontinental missile. And most important, it directly involves the NATO powers and gives them an element of control.

There is no question that it was genuinely urgent not only to meet the Russian threat but to do so visibly, in order to save the loosening NATO alliances. Our allies were fearful that the Soviet ballistic missile might mean that we were no longer able or willing to retaliate against the Soviet Union in case of an attack on them. We hastened to make public a reaction which would restore their confidence. This move surely appears to increase our own power to strike back, and also to give our allies a deterrent of their own, independent of our decision. It has also been argued that in this respect it merely advances the inevitable date at which our allies will acquire "modern" weapons of their own, and that it widens the range of Soviet challenges which Europe can meet. But we must face seriously the question whether this move will, in fact, assure either the ability to retaliate or the decision to attempt it, on the part of our allies or ourselves. And we should ask at the very least whether further expansion of this policy will buy as much retaliatory power as other ways of spending the considerable sums involved. Finally, it is important to be clear whether the Thor and Jupiter actually increase the flexibility or range of response available to allies.

One justification for this move is that it disperses retaliatory weapons and that this is the most effective sanction against the thermonuclear aggressor. The limitations of dispersal have already been discussed, but it remains to examine the argument that overseas bases provide *widespread* dispersal, which imposes on the aggressor insoluble problems of coordination.

There is, of course, something in the notion that forcing the enemy to attack many political entities increases the seriousness of his decision, but there is very little in the notion that dispersal in several countries makes the prob-

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lem of destruction more difficult in the military sense. Dispersal does not require separation by the distance of oceans—just by the lethal diameters of enemy bombs. And the task of coordinating bomber attacks on Europe and the eastern coast of the United States, say, is not appreciably more difficult than coordinating attacks on our east and west coasts. In the case of ballistic missiles, the elapsed time from firing to impact on the target can be calculated with high accuracy. Although there will be some failures and delays, times of firing can be arranged so that impact on many dispersed points is almost simultaneous—on Okinawa and the United Kingdom, for instance, as well as on California and Ohio. Moreover, it is important to keep in mind that these far-flung bases, while distant from each other and from the United States, are on the whole close to the enemy. To eliminate them, therefore, requires a smaller expenditure of resources on his part than targets at intercontinental range. For close-in targets he can use a wider variety of weapons carrying larger payloads and with higher accuracy.

The seeming appositeness of an overseas-based Thor and Jupiter as an answer to a Russian intercontinental ballistic missile stems not so much from any careful analysis of their retaliatory power under attack as from the directness of the comparison they suggest: a rocket equals a rocket, an intercontinental missile equals an intermediate-range missile based at closer range to the target. But this again mistakes the nature of the technological race. It conceives the problem of deterrence as that of simply matching or exceeding the aggressor's capability to strike first. A surprising proportion of the debate on defense policy has betrayed this confusion. Matching technological developments are useful for prestige, and such demonstrations have a vital function in preserving the alliance and in reassuring the neutral powers. But propaganda is not enough. The only reasonably certain way of maintaining a reputation for strength is to display an actual power to our friends as well as our enemies. We should ask, then, whether further expansion of the current programs for basing Thor and Jupiter is an efficient way to increase American retaliatory power. If overseas bases are considered too vulnerable for manned bombers, will not the same be true for missiles?

The basis for the hopeful impression that they will not is rather vague, including a mixture of hypothetical properties of ballistic missiles in which perhaps the dominant element is their supposedly much more rapid, "push-button" response. What needs to be considered here are the response time of such missiles (including decision, preparation, and launch times), and how they are to be defended.

The decision to fire a missile with a thermonuclear warhead is much harder to make than a decision simply to start a manned aircraft on its way, with orders to return to base unless instructed to continue to its assigned target. This is the "fail-safe" procedure practiced by the US Air Force. In contrast, once a missile is launched, there is no method of recall or deflection which is not subject to risks of electronic or mechanical failure. Therefore, such a decision must wait for much more unambiguous evidence of enemy intentions. It must and will take a longer time to make and is less likely to be made at all. Where more than one country is involved, the joint decision is harder still, since there is opportunity to disagree about the ambiguity of the evidence, as well as to reach quite different interpretations of national interest. On much less momentous matters the process of making decisions in NATO is complicated, and it should be recognized that such complexity has much to do with the genuine concern of the various NATO powers about the danger of accidentally starting World War III. Such fears will not be diminished with the advent of IRBMs. In fact, widespread dispersion of nuclear armed missiles raises immeasurably the possibility of accidental war.

Second, it is quite erroneous to suppose that by contrast with manned bombers the first IRBMs can be launched almost as simply as pressing a button. Countdown procedures for early missiles are liable to interruption, and the characteristics of the liquid-oxygen fuel limit the readiness of their response. Unlike JP-4, the fuel used in jet bombers, liquid oxygen cannot be held for long periods of time in these vehicles. In this respect such missiles will be *less* ready than alert bombers. Third, the smaller warning time available overseas makes more difficult any response. This includes, in particular, any active defense, not only against ballistic missile attacks but, for example, against low-altitude or various circuitous attacks by manned aircraft.

Finally, passive defense by means of shelter is more difficult, given the larger bomb yields, better accuracies, and larger forces available to the Russians at such close range. And if the press reports are correct, the plans for IRBM installations do not call for bomb-resistant shelters. If this is so, it should be taken into account in measuring the actual contribution of these installations to the West's retaliatory power. Viewed as a contribution to deterring all-out attack on the United States, the Thor and Jupiter bases seem unlikely to compare favorably with other alternatives. If newspaper references to hard bargaining by some of our future hosts are to be believed, it would seem that such negotiations have been conducted under misapprehensions on both sides as to the benefits to the United States.

But many proponents of the distribution of Thor and Jupiter—and possibly some of our allies—have in mind not an increase in US deterrence but the development of an independent capability in several of the NATO countries to deter all-out attack against themselves. This would be a useful thing if it can be managed at supportable cost and if it does not entail the sacrifice of even more critical measures of protection. But aside from the special problems of joint control, which would affect the certainty of response adversely, precisely who their legal owner is will not affect the retaliatory power of the Thors and Jupiters one way or the other. They would not be able to deter an attack which they could not survive. It is curious that many who question the utility of American overseas bases (for example, our bomber bases in the United Kingdom) simply assume that, for our allies, possession of strategic nuclear weapons is one with deterrence.

There remains the view that the provision of these weapons will broaden the range of response open to our allies. Insofar as this view rests on the belief that the intermediate-range ballistic missile is adapted to limited war, it is wide of the mark. The inaccuracy of an IRBM requires high-yield warheads, and such a combination of inaccuracy and high yield, while quite appropriate and adequate against unprotected targets in a general war, would scarcely come within even the most lax, in fact, reckless, definition of limited war. Such a weapon is inappropriate for even the nuclear variety of limited war, and it is totally useless for meeting the wide variety of provocation that is well below the threshold of nuclear response. Insofar as these missiles will be costly for our allies to install, operate, and support, they are likely to displace a conventional capability that might be gen-

uinely useful in limited engagements. More important, they are likely to be used as an excuse for budget cutting. In this way they will accelerate the general trend toward dependence on all-out response and so will have the opposite effect to the one claimed.

Nevertheless, if the Thor and Jupiter have these defects, might not some future weapon be free of them? Some of these defects, of course, will be overcome in time. Solid fuels or storable liquids will eventually replace liquid oxygen, reliabilities will increase, various forms of mobility or portability will become feasible, accuracies may even be so improved that such weapons can be used in limited wars. But these developments are all years away. In consequence, the discussion will be advanced if a little more precision is given such terms as "missiles" or "modern" or "advanced weapons." We are not distributing a generic "modern" weapon with all the virtues of flexibility in varying circumstances and of invulnerability in all-out war. But even with advances in the state of the art on our side, it will remain difficult to maintain a deterrent, especially close in under the enemy's guns.

It follows that, though a wider distribution of nuclear weapons may be inevitable, or at any rate likely, and though some countries, in addition to the Soviet Union and the United States, may even develop an independent deterrent, it is by no means inevitable or even very likely that the power to deter all-out thermonuclear attack will be widespread. This is true even though a minor power would not need to guarantee as large a retaliation as we in order to deter attack on itself. Unfortunately, the minor powers have smaller resources as well as poorer strategic locations. Mere membership in the nuclear club might carry with it prestige, as the applicants and nominees expect, but it will be rather expensive, and in time it will be clear that it does not necessarily confer any of the expected privileges enjoyed by the two charter members. The burden of deterring a general war as distinct from limited wars is still likely to be on the United States and, therefore, so far as our allies are concerned, on the military alliance.

There is one final consideration. Missiles placed near the enemy, even if they could not retaliate, would have a potent capability for striking first by surprise. And it might not be easy for the enemy to discern their purpose. The existence of such a force might be a considerable provocation and, in fact, a dangerous one in the sense that it would place a great burden on our deterrent force which more than ever would have to guarantee extreme risks to the attacker—worse than the risks of waiting in the face of this danger. When not coupled with the ability to strike in retaliation, such a capability might suggest—erroneously, to be sure, in the case of the democracies—an intention to strike first. If so, it would tend to provoke rather than to deter general war.

I have dealt here with only one of the functions of overseas bases: their use as a support for the strategic deterrent force. They have a variety of important military, political, and economic roles which are beyond the scope of this paper. Expenditures in connection with the construction or operation of our bases, for example, are a form of economic aid and, moreover, a form that is rather palatable to the Congress. There are other functions in a central war where their importance may be very considerable and their usefulness in a limited war might be substantial.

Indeed nothing said here should suggest that deterrence is in itself an adequate strategy. The complementary requirements of a sufficient military policy cannot be discussed in detail here. Certainly they include a more serious development of power to meet limited aggression, especially with more advanced conventional weapons than those now available. They also include more energetic provision for active and passive defenses to limit the dimensions of the catastrophe in case deterrence should fail. For example, an economically feasible shelter program might make the difference between 50,000,000 survivors and 120,000,000 survivors.

But it would be a fatal mistake to suppose that because strategic deterrence is inadequate by itself it can be dispensed with. Deterrence is not dispensable. If the picture of the world I have drawn is rather bleak, it could nonetheless be cataclysmically worse. Suppose both the United States and the Soviet Union had the power to destroy each other's retaliatory forces and society, given the opportunity to administer the opening blow. The situation would then be something like the old-fashioned western gun duel. It would be extraordinarily risky for one side *not* to attempt to destroy the other, or to delay doing so, since it not only can emerge unscathed by striking first but this is the sole way it can reasonably hope to emerge at all. Evidently such a situation is extremely unstable. On the other hand, if it is clear that the aggressor, too, will suffer catastrophic damage in the event of his aggression, he then has strong reason not to attack, even though he can administer great damage. A protected retaliatory capability has a stabilizing influence not only in deterring rational attack, but also in offering every inducement to both powers to reduce the chance of accidental war.

The critics who feel that deterrence is "bankrupt" sometimes say that we stress deterrence too much. I believe this is quite wrong if it means that we are devoting too much effort to protect our power to retaliate; but I think it is quite right if it means that we have talked too much of a strategic threat as a substitute for many things it cannot replace.

DETERRENCE, ACCIDENTS, AND DISARMAMENT

Up to now I have talked mainly about the problem of deterring general war, of making it improbable that an act of war will be undertaken deliberately, with a clear understanding of the consequences, that is, rationally. That such deterrence will not be easy to maintain in the 1960s simply expresses the proposition that a surprise thermonuclear attack might *not* be an irrational or insane act on the part of the aggressor. A deterrent strategy is aimed at a rational enemy. Without a deterrent, general war is likely. With it, however, war might still occur.

In order to reduce the risk of a rational act of aggression, we are being forced to undertake measures (increased alertness, dispersal, mobility) which, to a significant extent, increase the risk of an irrational or unintentional act of war. The accident problem is serious, and it would be a great mistake to dismiss the recent Soviet charges on this subject as simply part of the war of nerves. In a clear sense the great multiplication and spread of nuclear arms throughout the world, the drastic increase in the degree of readiness of these weapons, and the decrease in the time available for the decision on their use must inevitably raise the risk of accident. The B-47 accidents this year at Sidi Slimane and at Florence, S. C., and the recent Nike explosions are just a beginning. Though incidents of this sort are not themselves likely to trigger misunderstanding, they suggest the nature of the problem.

There are many sorts of accidents that could happen.

(Continued on following page)

There can be electronic or mechanical failures of the sort illustrated by the B-47 and Nike mishaps; there can be aberrations of individuals, perhaps quite low in the echelon of command; there can be miscalculations on the part of governments as to enemy intent and the meaning of ambiguous signals. Not all deterrent strategies will involve the risk of accident equally. One of the principles of selecting a strategy should be to reduce the chance of accident, wherever we can, without a corresponding increase in vulnerability to a rational surprise attack. This is the purpose of the "fail-safe" procedures for launching SAC.

These problems are also relevant to the disarmament question. The Russians, exploiting an inaccurate United Press report which suggested that SAC started en masse toward Russia in response to frequent radar "ghosts," cried out against these supposed Arctic flights. The United States response, and its sequels, stated correctly that such flights had never been undertaken except in planned exercises and would not be undertaken in response to such unreliable warning. We pointed out the importance of quick response and a high degree of readiness in the protection of the deterrent force. The nature of the fail-safe precaution was also described.

We added, however, to cap the argument, that if the Russians were really worried about surprise attack they would accept the President's "open skies" proposal. This addition, however, conceals an absurdity. Aerial photography would have its uses in a disarmament plan—for example, to check an exchange of information on the location of ground bases. However, so far as surprise is concerned, an "open skies" plan would have direct use only to discover attacks requiring much more lengthy, visible, and unambiguous preparations than are likely today. The very readiness of our own strategic force suggests a state of technology which outmodes the "open skies" plan as a counter to surprise attack. Not even the most advanced reconnaissance equipment can disclose an intention from 40,000 feet. Who can say what the men in the blockhouse of an ICBM base have in mind? Or, for that matter, what is the final destination of training flights or fail-safe flights starting over the Pacific or North Atlantic from staging areas?

The actions that need to be taken on our own to deter attack might usefully be complemented by bilateral agreements for inspection and reporting and, possibly, limitation of arms and of methods of operating strategic and naval air forces. But the protection of our retaliatory power remains essential; and the better the protection, the smaller the burden placed on the agreement to limit arms and modes of operation and to make them subject to inspection. Reliance on "open skies" alone to prevent surprise would invite catastrophe and the loss of power to retaliate. Such a plan is worthless for discovering a well prepared attack with ICBMs or submarine-launched missiles or a routine mass training flight whose destination could be kept ambiguous. A tremendous weight of weapons could be delivered in spite of it.

Although it is quite hopeless to look for an inspection scheme which would permit abandonment of the deterrent, this does not mean that some partial agreement on inspection and limitation might not help to reduce the chance of any sizable surprise attack. We should explore the possibilities of agreements involving limitation and inspection. But how we go about this will be conditioned by our appreciation of the problem of deterrence itself.

The critics of current policy who perceive the inadequacy of the strategy of deterrence are prominent among those urging disarmament negotiations, an end to the arms race and a reduction of tension. This is a paramount interest of some of our allies. The balance of terror theory is the basis for some of the more lighthearted suggestions: If deterrence is automatic, strategic weapons on one side cancel those of the other, and it should be easy for both sides to give them up. So James E. King, Jr., one of the most sensible writers on the subject of limited war, suggests that weapons needed for "unlimited" war are those which both sides can most easily agree to abolish, simply because "neither side can anticipate anything but disaster" from their use. "Isn't there enough stability in the 'balance of terror,'" he asks, "to justify our believing that the Russians can be trusted—within acceptable limits—to abandon the weapons whose 'utility is confined to the threat or conduct of a war of annihilation'?"

Indeed, if there were no real danger of a rational attack, then accidents and the "nth" country problem would be the only problems. As I have indicated, they are serious problems and some sorts of limitation and inspection agreement might diminish them. But if there is to be any prospect of realistic and useful agreement, we must reject the theory of automatic deterrence. And we must bear in mind that the more extensive a disarmament agreement is, the smaller the force that a violator would have to hide in order to achieve complete domination. Most obviously, "*the abolition* of the weapons necessary in a general or 'unlimited' war" would offer the most insuperable obstacles to an inspection plan, since the violator could gain an overwhelming advantage from the concealment of even a few weapons. The need for a deterrent, in this connection, too, is ineradicable.

Almost everyone seems concerned with the need to relax tension. However, relaxation of tension, which everyone thinks is good, is not easily distinguished from relaxing one's guard, which almost everyone thinks is bad. Relaxation, like Miltown, is not an end in itself. Not all danger comes from tension. To be tense where there is danger is only rational.

What can we say then, in sum, on the balance of terror theory of automatic deterrence? It is a contribution to the rhetoric rather than the logic of war in the thermonuclear age. The notion that a carefully planned surprise attack can be checkmated almost effortlessly, that, in short, we may resume our deep pre-Sputnik sleep, is wrong and its nearly universal acceptance is terribly dangerous. Though deterrence is not enough in itself, it is vital. There are two principal points.

First, deterring general war in both the early and late 1960s will be hard at best, and hardest both for ourselves and our allies wherever we use forces based near the enemy.

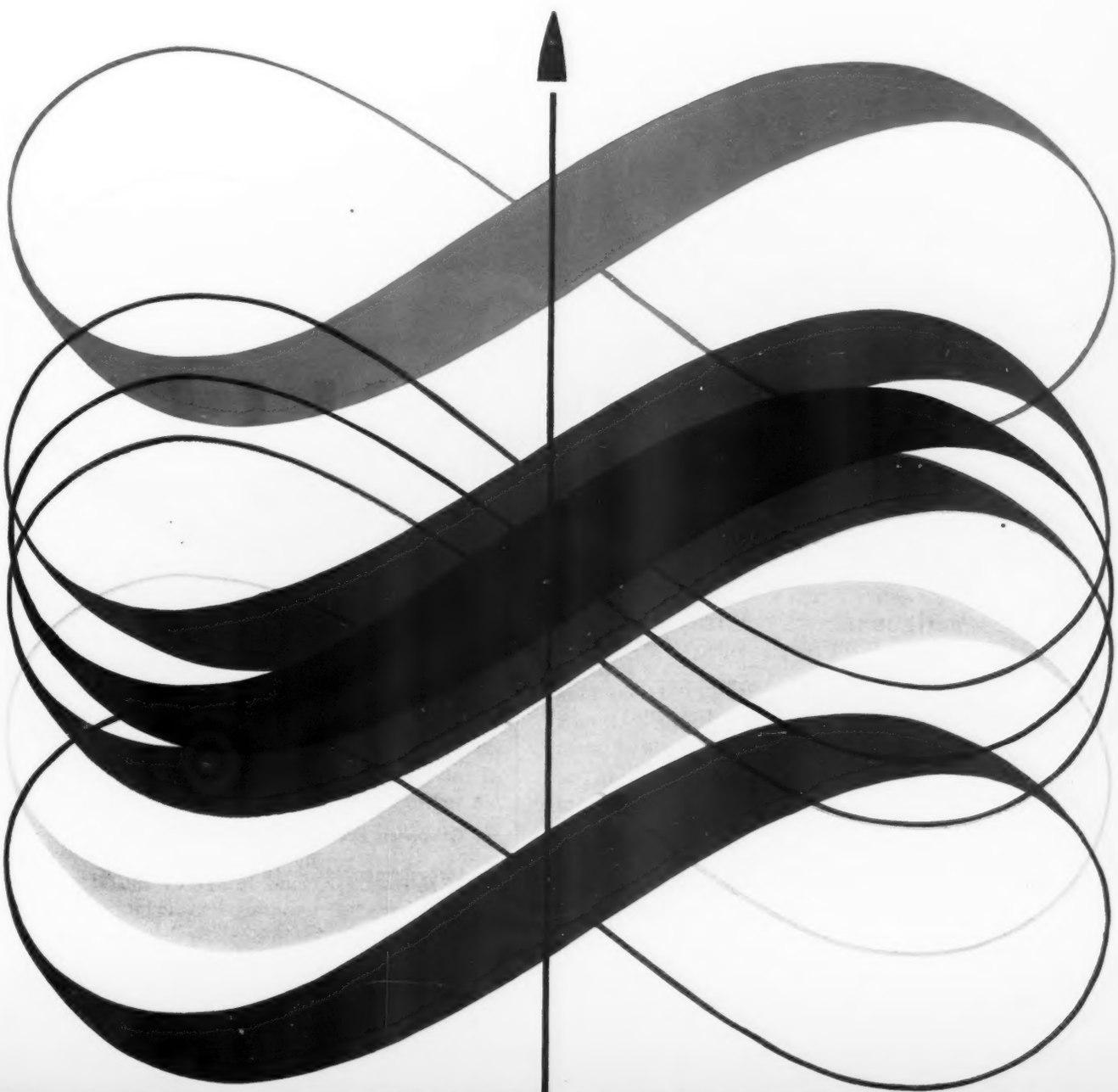
Second, even if we can deter general war by a strenuous and continuing effort, this will by no means be the whole of a military, much less a foreign policy. Such a policy would not of itself remove the danger of accidental outbreak or limit the damage in case deterrence failed; nor would it be at all adequate for crises on the periphery.

A generally useful way of concluding a grim argument of this kind would be to affirm that we have the resources, intelligence, and courage to make the correct decisions. That is, of course, the case. And there is a good chance that we will do so. But perhaps, as a small aid toward making such decisions more likely, we should contemplate the possibility that they may *not* be made. They are *hard, do* involve sacrifice, *are* affected by great uncertainties, and concern matters in which much is altogether unknown and much else must be hedged by secrecy; and, above all, they entail a new image of ourselves in a world of persistent danger. It is by no means *certain* that we shall meet the test.—END

February • 1959

SPACE DIGEST

THE SPACE AGE IN PERSPECTIVE



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SPACE DIGEST

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From the Editors...

COMPILING a digest of provocative ideas on any subject—particularly as exciting a subject as astronautics—is a rewarding task. It's rough on the eyes, too, but good for the brain. As the months go by, an increasing river of journals, articles, speeches, and reports floods our office.

The content of this month's SPACE DIGEST reflects this wide range of sources for selection. In fact, the articles that appear this month originated in publications as diverse in their audience as *Playboy* and *Parents'* Magazines.

Names like Margaret Mead, Harlow Shapley, Charles Frankel, and Anthony Boucher are honored in the academic and literary circles. It is our privilege to publish their ideas on these pages.

Aside from philosophical aspects of the space age, there are hard facts that have to be faced. As the year began, the House of Representatives released a report, among several others, all valuable, called "The United States and Outer Space." Bluntly it called for far greater effort, keyed to survival, by our country. And it spelled out the still not universally understood point that we may forfeit our freedom if we do not face up to the stakes involved in the technological war.

The present organization of our space effort as rendered in the drawings on pages 68 and 69, offers an interesting, if not altogether encouraging, picture of how we are "girding" for survival.

Above; final adjustments on Atlas, before it roared into orbit from Cape Canaveral at year's end.

WE ORBITED ATLAS, BUT *Soviets*

WILLIAM LEAVITT
Associate Editor

THE solar system's nine familiar planets coursing around the sun now have a new neighbor. As heavenly bodies go, the tenth planet, *Mechta* (dream) or "Lunik," presumably in a solar orbit, isn't much. There are heavier hunks of natural rock (possible remains of a shattered planet) in the asteroid belt that orbits the sun. But as a further jolting demonstration of Soviet dead earnestness in the technological war, the Red rocket is unquestionably a major achievement—this in spite of the fact that an increasing number of people are pointing out that the Russian mission actually overreached its objective, the moon.

This original objective, which if attained would have been a formidable performance of both thrust and guidance, was doubly obscured in the flood of news that accompanied the Russian rocket's ride into the void. The Soviets were deliberately vague in their announcement of the mission of the Lunik, yet the description of the instrumentation and the popular name Lunik gave the impression it was a lunar probe—and our own press, excited by its thrust, bought the quick Soviet shift to the "cosmic rocket-solar probe" promotion of the Russian propaganda mill.

These observations in no way minimize the Soviet achievement. In this primitive age of space technology, to have the skill (and luck) to get to the relative vicinity of your target and then to overshoot it because your thrust and consequent inertial speed were too great is a fantastic accomplishment. If the Russians follow the course they have so dramatically traced since October 4, 1957, there is little doubt that they will—as they say they will—safely recover a man from orbit before we do, succeed in landing instrument packages on the moon, and perform the rest of the natural sequence: land a party on the moon, set up shop there, and strike an awe into the uncommitted peoples of the world that may retire our country to the permanent status of a second-class power. These are frightening realities and they have to be accepted realistically.

Yet, as reported here last month, there have been undeniable advances in the space effort on our side. Literally as we went to press last month, the Atlas "talking satellite" was announced. And it is painful to recall the too-loud burst of applause that went up, along with editorial statements mistakenly stressing the great weight of Atlas compared with the Russian Sputniks. People

Wide World Photos, Inc.

Red showmanship. This photo, made in Scotland, is believed to have caught on film the sodium cloud released from Mechta *as it streaked toward space.*

Stole Our Thunder

SOME REASONS WHY

who follow the space story closely were quick to point out that the payload of Sputnik III was heavier than Atlas' payload and that it was less than candid to talk sheer weight of Atlas as an achievement in itself. Comparisons: Sputnik III payload—2,129 pounds; Atlas payload—167 pounds. The achievement of Atlas was, as pointed out last month in SPACE DIGEST, the demonstration of guidance capability and the feasibility of satellite use for communications.

The how and why of both the Atlas and Lunik shoots is a different story entirely. Aside from the intrinsic worth of what was really a USAF achievement, an increasing number of observers are wondering how long we can stay in the technological race using what appears to be almost an "intuitive" approach. Getting the Atlas into orbit, according to some accounts, was the result of a conference in which the question was asked, almost plaintively: "What can we do that's big—really big?" A small band of people were bound to secrecy, and the Atlas did its stuff. It's not inconceivable that the Russians may have even had the luck to be able to postpone their Lunik shot long enough to leave the West happy over the holidays so that they could accomplish an even more effective one-two punch a few weeks later.

It becomes clearer, as the race proceeds, that the Soviets have now and have had for a considerable time a well-thought-out space program, a budget to pay for it, and the scientists to do the job. In addition, they have excited their people with tantalizing pictures of a future in which Soviet technology will make more comfortable the lives of the many. Except for the rigidity of their political dogmas, the Russians are going about things in a way that is really quite American in tone. For an interesting graphic representation of the US national space effort, see pages 68 and 69. It tells a somewhat confusing story. Although, as yet, no complete chart of the Soviet setup is available, it is difficult to imagine that they have as complicated and diffused an arrangement.

We used to poke fun, in the early days of Communism, at the plethora of commissars and committees assigned to handle particular jobs. Why not just give someone the responsibility and get it done was our reaction to the commissariats of yesteryear. Now the tables seem to have turned.

It's possible, in the light of present events, that the Russians are beginning to wonder about us the way we used to about them.—END

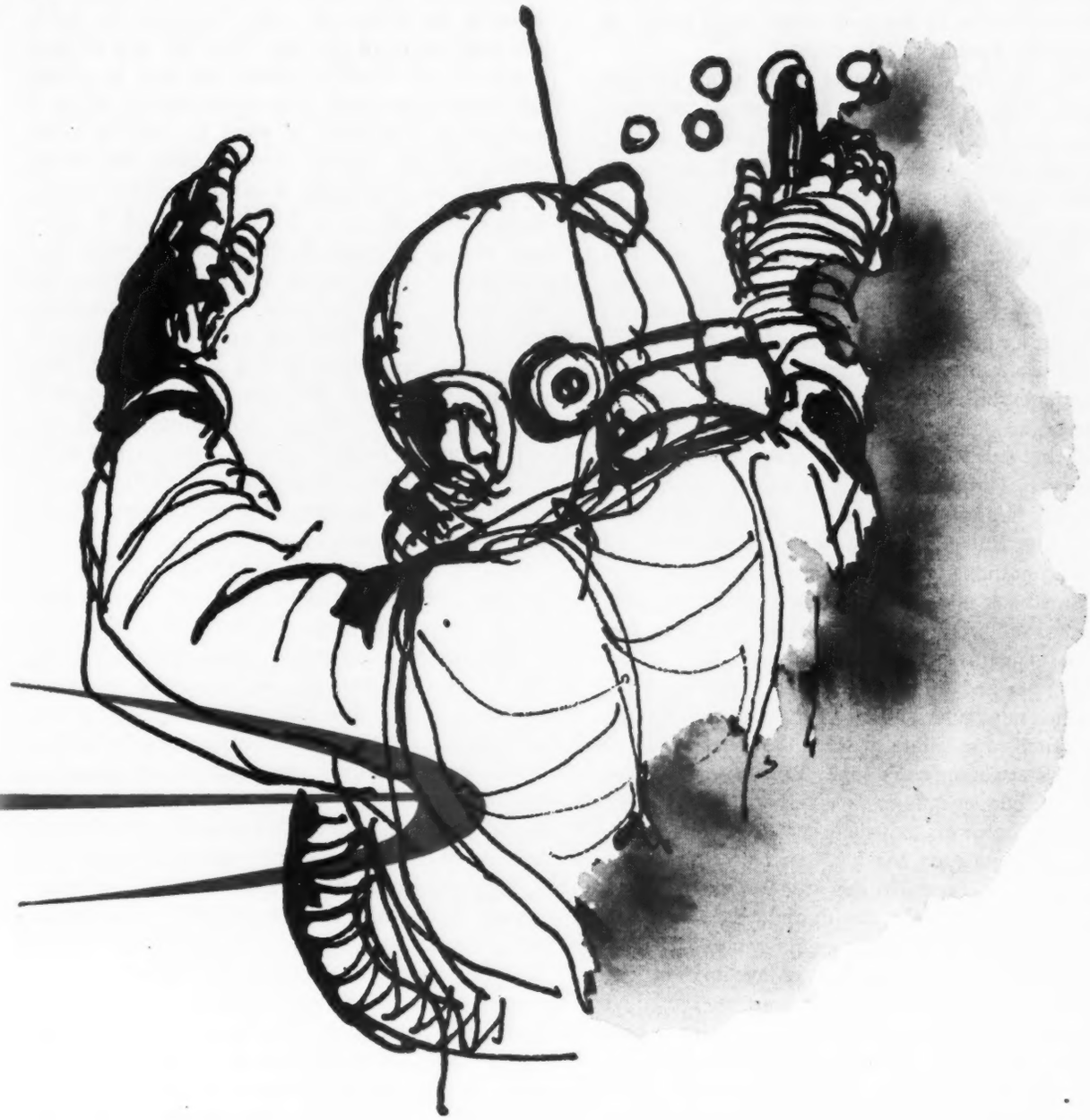
MANKIND'S THIRD GREAT REVOLUTION

The first change came when man the hunter became man the farmer. The second came with the machine. Now the satellite symbolizes a new "age of acceleration"

CHARLES FRANKEL

PROBABLY no event in recent years has had a greater impact on the American mood than the Soviet Union's success in launching artificial satellites. The Sputniks stirred justified anxieties about America's position in the cold war and upset some of our tenderest assumptions about our situation. But more than this, the Sputniks—and now our own Explorers—have turned loose some bewildering predictions about the future. . . .

But while predictions about man's future career in outer space have an undeniable interest, the satellites, it may be suspected, also have a significance that is a bit closer to earth and closer to home. For they are not merely events in an armaments race or science-fiction stories come true. They are peculiarly dramatic symbols of what has been going on backstage, east and west, during the last fifteen years—a sudden extension of scientific intelligence and technical resourcefulness which represents an extraordinary spurt of human intellect and power. And this spurt of the human mind has social and moral, as well as technological, consequences. The Sputniks are signs in the skies that the normal human scene is changing in some of its fundamental character-



istics and that we are living in the midst of a fundamental revolution in human affairs.

Some 25,000 years ago an "Agricultural Revolution" took place which changed man from a nomadic hunter and berry picker into a deliberate cultivator of his food supply. In the latter half of the eighteenth century an "Industrial Revolution" began with results which we have not yet fully absorbed. Both these revolutions began as changes in the ideas and tools men had used to adjust themselves to nature. They ended by changing men's relations to each other, their moral and political outlooks, and the very substance of the things they thought worth seeking in life. It is easy to overestimate the significance of events that happen in one's own day. But the revolution that has taken shape in the last fifteen years must be put in company like this to be seen in its proper perspective.

Indeed, in the natural energies it has released, and in the speed with which it has done so, the present shift in the relation of man to his environment dwarfs either of its predecessors. It is impossible to believe that its other consequences will not eventually be as great. Now that we have had a chance to absorb the first impact of the

Sputniks, it may be worthwhile to sit back and reflect on some of the long-range social issues of which the Sputniks are a portent.

We can already see some of the more obvious issues. War, for example, has changed its character and has lost one of its traditional functions in international affairs. Leaving all issues of morality aside, large-scale war can no longer be used, as it has sometimes been used in the past, as an intelligent instrument even of national selfishness. While the danger of all-out nuclear war has not substantially receded, such war can only be an instrument of utter desperation.

Similarly, the problem posed by the expansion of population in the world promises to become even more acute as a result of the advances in medicine and technology that are almost surely in prospect. Through most of its history the human race has had to struggle to keep its numbers from declining. But our very success in improving the basic conditions of human existence now threatens to turn back upon us and to lead to incalculable human suffering unless organized measures are taken to control the birth rate.

But war and the growth of the world's population are relatively familiar problems, even though the penalty for failing to solve them has suddenly become astronomically high. The present revolution in human affairs is likely to bring other changes, however, to which somewhat less attention has been paid. And not the least important is a possible change in the way in which human work will be organized with the advent of new industrial processes such as automation.

One possible consequence of automation, for example, is a sharp increase in the ratio of skilled workers to unskilled workers. This means a host of new issues for industrial unions, and new problems for both labor leaders and industrial managers. Of equal significance is the possible impact of the automatic factory on the way in which the working day may be arranged. As the British engineer Landon Goodman has pointed out, the cost of introducing automation may be so high in many cases that it will be uneconomical to operate a plant only eight hours a day. If many industrial plants are going to find it necessary to operate around the clock, obvious consequences will follow for everything from the nature of home life to the way in which cities are organized. Even the old phrase, "as different as night and day," is likely to lose some of its force.

The new way in which work may be organized also affects the attitude that men may take toward the other parts of life. Most of the work that men have had to do in history has been disagreeable; most of the leisure that men have had has been the prerogative of the few. This fact has colored much of our thinking about the way in which life ought to be lived. The democratically minded have been suspicious of what is "useless"; the aristocratically minded have regarded the useful as just a bit vulgar. But if leisure becomes everybody's prerogative (and problem), and if automation can be used to make human work less routine and to give more workers the opportunity to exercise their individual skills and discretion, the sharp division between work and leisure will make even less sense than it makes today. The effects will be felt, to take only one example, in our ideals of "liberal" education, which are still primarily leisure oriented, and in our conception of "vocational" education, which is already anachronistic in its view of what ordinary people need to be "prepared for life."

But the new processes of industrial production are parts of a larger trend which has even deeper implications of its own. During most of the past, developments in technology were largely independent of developments in pure scientific research. To some extent this remained true even in the nineteenth century. But technology has now become almost entirely the child of fundamental theoretical inquiry. This means that we can count in the future on a steady process of technological innovation, and at a steadily more rapid pace. . . .

This quickened tempo represents an unprecedented challenge to the human ability to adjust to social change. It took man roughly 475,000 years to arrive at the Agricultural Revolution. It required another 25,000 years to come to the Industrial Revolution. We have arrived at the "Space Age" in a hundred and fifty years—and while we do not know where we go from here, we can be sure that we shall go there fast. Our expectations of change, and the ability of our nervous systems or our social systems to withstand the shock of change, have been formed in the long experience of the race. And this experience, even in the nineteenth century, has not prepared us for the pace of events that lie ahead.

Such an extraordinary change in the basic tempo of human history means that new and deliberate efforts will be needed to control the processes of social change. As the last hundred years of Western history demonstrate, men can learn to change at a much quicker pace than before. But as these same years also suggest, there are limits, and it is difficult to imagine a day when it will not take time for men to adjust to new

conditions, to learn new skills and habits, and to get over the nostalgia and resentments that come when old and familiar things are destroyed. . . .

Accordingly, if the things we cherish from the past are not going to be carefully destroyed, and if the best possibilities of the future are going to be realized, it seems probable that we shall have to have institutions that have been deliberately set up to exercise long-range social forethought. A steady process of technological innovation, for example, can mean recurrent crises of technological unemployment. If this is not to happen, institutions will have to exist to envisage the new skills that will be needed, to undertake the continuing task of retraining workers, and to control the pace at which new techniques are introduced so that we can make a sensible adjustment to them. Given the pace and magnitude of the technical changes that are in prospect, we cannot count on the market place and the price system to do this job alone. Technological innovation means social change; and there is no more reason to introduce such innovations, letting the chips fall where they may, than there is to introduce a new and powerful drug on the market without first making it meet the test of medical examination and control.

The need to exercise more deliberate control over the processes of social change raises, of course, a fundamental issue. It is the issue of freedom and regimentation, the question of the tension between personal liberty and initiative on the one hand, and the obvious and growing necessity on the other, for an ever larger degree of social organization. This has been the central issue in industrial society for more than a century. In the world which the present revolution is forming it will be equally decisive. But the terms we have habitually employed in trying to solve it will almost certainly need to be revised.

The dangers that a larger degree of social organization can bring are obvious. It can mean, at the very least, a multiplication of the nuisances that exhaust individual energy—administrative forms to fill out, incessant committees, petty bureaucratic tyrannies. It can mean that power will steadily pile up at the center until it is impossible to place an effective check upon it. Perhaps, worst of all, our ideals and attitudes can change.

Under the pressure of the need for organization, we can come slowly but painlessly to like the standard and the impersonal, and to prefer the man who fits the system to the man who is difficult to harness. If this happens, we can lose liberties we now cherish and never notice or regret the loss.

But the individual can be crushed just as easily in a subway rush as on an assembly line. When there is more traffic on the streets, more controls are necessary. And when these controls are inadequate or break down, the individual has less freedom to go where he wants to go, not more freedom. The question, in brief, is not whether we shall have a larger amount of conscious social organization or not, but what kind of social organization we shall have. It can be centralized or decentralized; it can be broken up into small units or cover only very large ones; it can concentrate authority up at the top or spread considerable authority down to lower levels. Most important of all, it can have as its conscious object the cherishing of individual differences and the promotion of individual talents. The dangers of a larger degree of social organization are unmistakable. But disorganization will be no healthier a climate for freedom.

The problems of social organization and of controlling the results of technological innovation bring us, however, to a final problem. It is the problem of the use and abuse of science, a problem that is likely to become steadily more acute as our world becomes more steadily and obviously a creature of science. In the future, as in the past, two extreme possibilities confront us. The first is to make an idol out of science. The second is to denigrate its importance on grounds of fixed moral or religious principle.

Illustrations of the tendency to make an idol out of science have suddenly blossomed all around us since the Sputniks began their dance in space. With a hopefulness that is somewhat frightening, both scientists and laymen have predicted, for example, that science will soon be able to change human emotions and desires by biochemical means. Others have talked about the coming mastery of the principles of "group dynamics" and the ability that science will give us to choose the right leaders and to get people to work together harmoniously.

Such predictions represent revivals of Plato's ancient dream that, if philosophers became kings, man's political and moral troubles would come to an end. And they rest on precisely the same combination of political innocence and moral arrogance. There is, unhappily, no guarantee that those who dispense the pills that are going to change our desires and emotions will themselves have the right desires and emotions.

But it is a grave mistake to dismiss science

as useless in solving moral and political problems. Objective knowledge of the conditions and consequences of our personal desires or our social institutions does help us to realize the actual nature of the ends we choose to pursue; and in this way we can frequently come to choose our ends and ideals more intelligently.

Even more than in the past, the world which the present revolution is creating will be one in which a process of steady reexamination of existing institutions will be a condition, not simply of a decent life, but in all probability of survival as well. Those who take fixed positions in such a world, and who deny the usefulness of scientific knowledge in resolving moral and political dilemmas, will be pleading merely for the rule of dogma or of their own private intuitions. It is unreasonable and unattractive to think that the society of the future should be ruled by a scientific elite masquerading as moral experts. It is equally unattractive to think that it should be ruled by those who make a principle of ignorance, and whose claim to be moral experts rests on their sense of superiority to the processes of sober scientific inquiry.

The attitudes that are aroused by science suggest, indeed, the fundamental educational problem which the present revolution puts before us. This revolution is at bottom the product of ideas and modes of thought which have remained closed secrets to most of the best educated men and women today. As a result, in what is alleged to be the most "scientific" of ages, science has the quality of magic for the popular mind. But while the problem is critical, it is not insurmountable.

The difficulties of acquainting college-trained men and women with the fundamental methods and ideals of contemporary science have been greatly exaggerated. It requires, of course, the imparting of factual information; but it requires, even more, the training of the imagination of the ordinary, educated layman so that he can grasp the general character of scientific problems even if he does not understand all their details, and can appreciate the kind of triumph which the solution of such problems represents.

Such an imaginative grasp of science, which would allow more members of modern culture to share vicariously in the most majestic achievements of their civilization, is possible for a great many more than now have it. And even more than the problem of training more scientists and engineers, this is the fundamental problem of education in the sciences.

As one looks ahead to the unfamiliar world that is emerging, it is possible, of course, to feel overwhelmed by this educational problem or by the other problems which this world puts before us. One can try to retreat from the unfamiliar, either by laughing off artificial satellites as mere basketballs in outer space or by concentrating almost hysterically on just one short-range issue—the military struggle for outer space to the neglect of all the other issues that artificial satellites dramatize. And one can also take an apocalyptic attitude and assume that the unfamiliar world that is emerging is also going to be absolutely unrecognizable, whether for the better or for the worse. But human traits like envy, malice, and egoism are likely to remain with us no matter what moral medicines the druggist of the future has on his shelves. And once the initial thrill wears off, most honeymooners are probably going to prefer the moon overhead rather than underfoot.

But if utopia is not around the corner, neither is it inevitable that our powers are unequal to the problems that are appearing. In an age whose problems are almost all signs of mounting human powers, this would be a strange moral to draw. Man is now making his own stars and setting his own impress on the solar system. If these stars are as yet minuscule and only a very little way out in space, they still represent something of an achievement for a creature who is built rather close to the ground. The world that is taking shape can preserve old joys and it can also contain many new ones. The scientific imagination of the twentieth century has shown remarkable flexibility and daring. There is no reason in the nature of things why our social imagination cannot show some of the same qualities, or why it cannot escape, as modern science has, from the backyard of its old commonplaces and dogmas. If it did, its achievements could be even greater than the shooting of satellites into the sky.—END

The author of this provocative discussion of man and speed, Charles Frankel, is a Professor of Philosophy at Columbia University and the author of the book, The Case for Modern Man. *The article is reprinted here with permission of the New York* Times, *having appeared in the New York* Times Magazine *for Sunday, February 9, 1958, and with permission of the author, whose words, now nearly a year old, ring even truer against the background of a talking Atlas and the man-made new planet hurtling in orbit around the sun.*

A LOOK AT

Our National Space Effort

SOME WEEKS ago we decided it would be a public service if we were to spell out in a chart the basic organization of this country's space effort. We have done this in the past with our AIR FORCE Magazine command photocharts and usually, with the requisite amount of digging, it has been possible to portray the flow of authority from decision-making to operating levels.

In our research on the space effort organization, however, it soon became apparent that the usual sort of chart was not honestly possible. What emerged instead was a *series of relationships* which had to be pictured. The drawing on the following pages represents those relationships somewhat in the structure of a molecule and its component atoms. It does not indicate flow of authority, primarily because so far as we were able to determine, lines of authority are extremely difficult to locate or, even more typically, are notably absent.

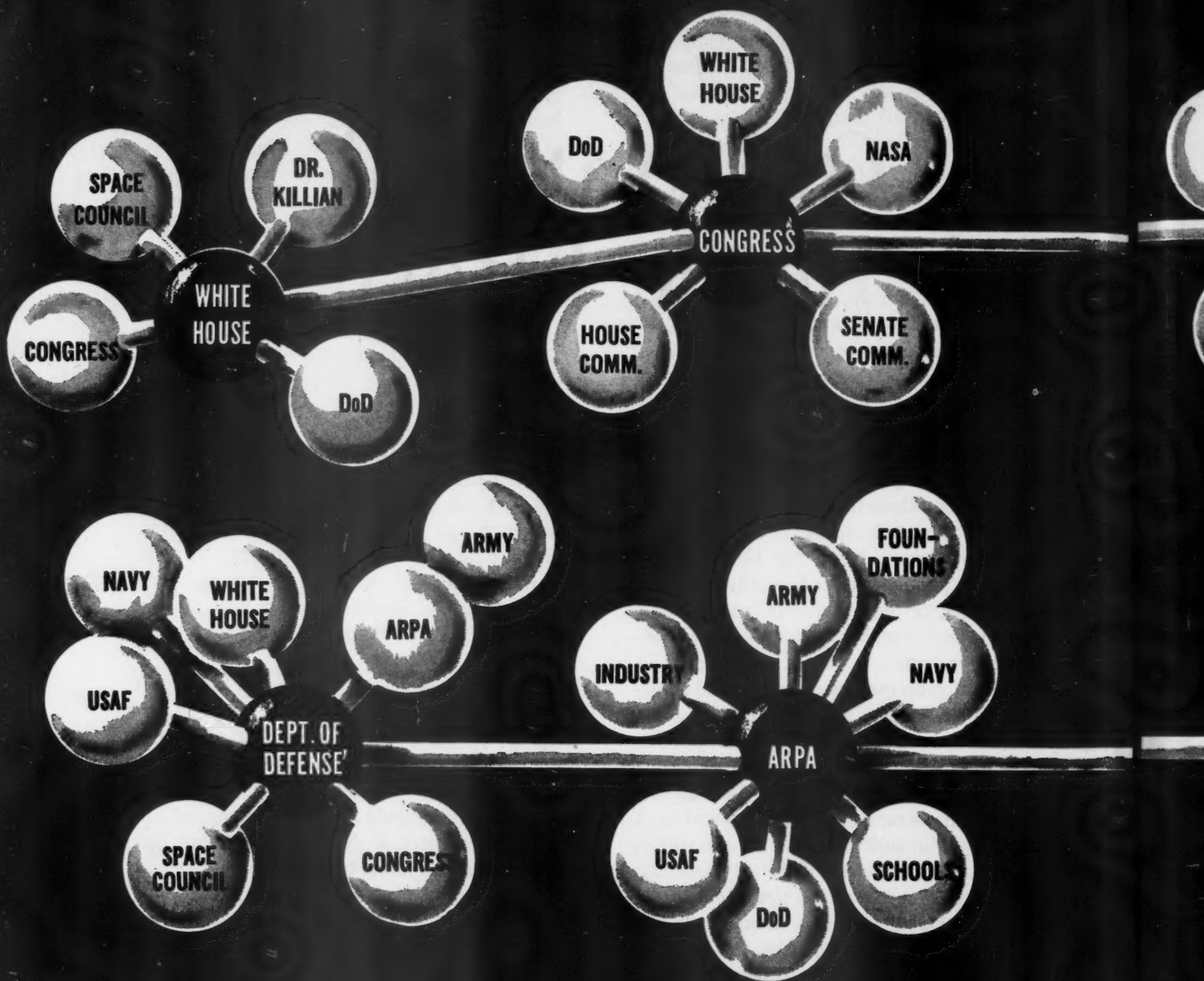
As the drawing indicates, there are a number of people and agencies, from the President down, as well as the industry and educational institutions which provide the backup, comprising the total national space activity. At the President's side is Dr. James R. Killian, his Special Adviser for Science and Technology, whose primary assignment is providing scientific counsel to the President but who does not *per se* call the shots for projects, except in terms of the weight of his scientific prestige and position.

Also in direct relationship to the President is the National Aeronautics and Space Council, created by the act that also brought into being the National Aeronautics and Space Administration. The NASC is roughly analagous to the National Security Council. NASC's members include Secretary of Defense Neil H. McElroy; Secretary of State John Foster Dulles; Atomic Energy Commission chairman John McCone; NASA administrator T. Keith Glennan; Space Technology Laboratories board chairman James H. Doolittle; National Science Foundation director, Dr. Alan Waterman; National Academy of Science president Dr. Detlev W. Bronk; and New York attorney William A. Burden. President Eisenhower is chairman.

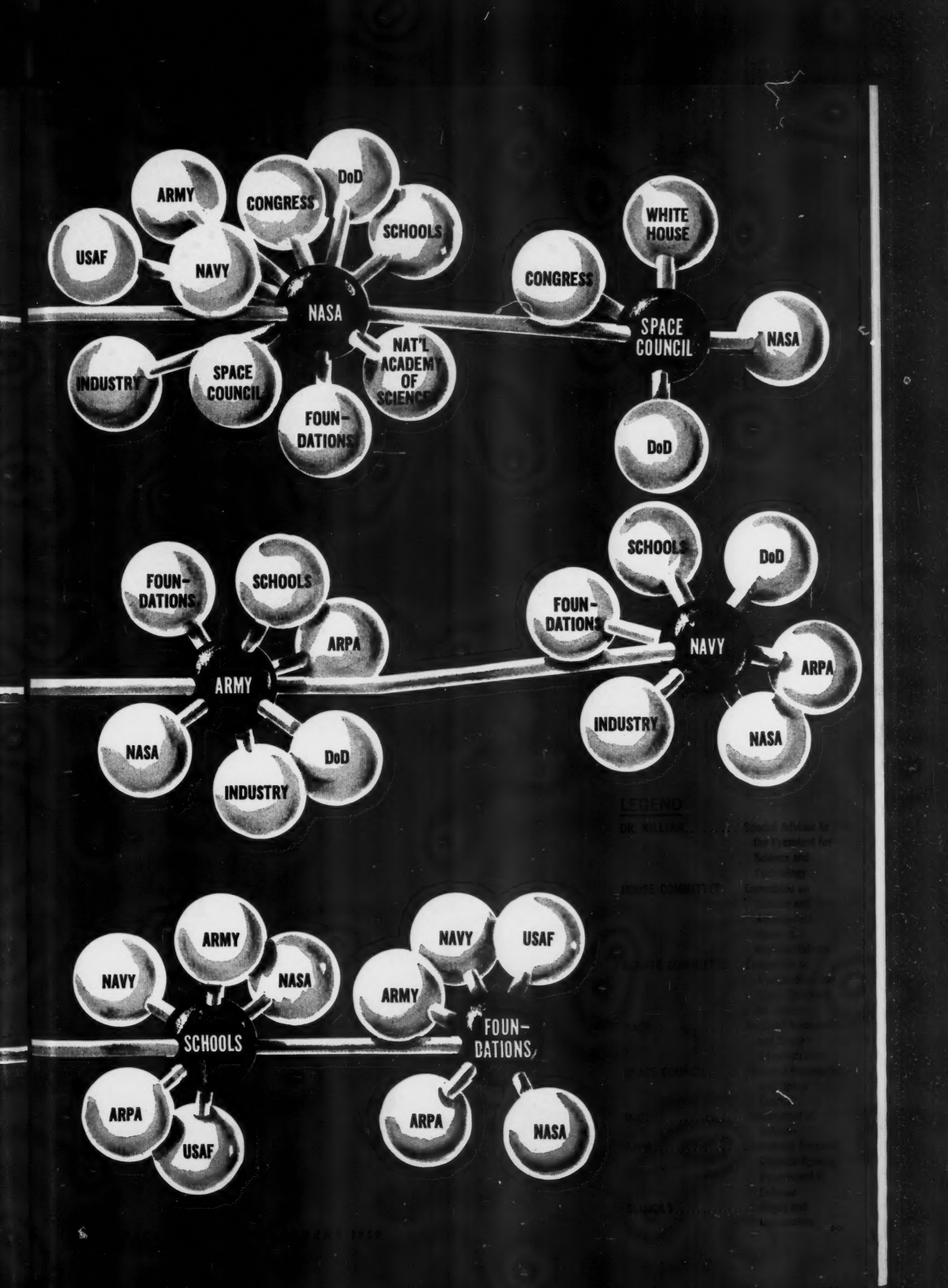
The Council, which at this writing had reportedly met only three times since its inception, was designed to settle policy questions concerning space planning, and to advise the President, when necessary, on such specifics as whether military or civilian agencies should handle development of a given space project, if differences have not been adjusted in negotiations between Defense Department's Advanced Research Projects Agency and the civilian NASA. In turn, both ARPA and NASA have working relationships with the three military services and their hardware and research facilities. A notable example of this sort of relationship is the ARPA Project Discoverer program at Vandenberg AFB, Calif., to be performed by the Air Force. Other examples would be the Air Force and Army lunar probes, directed by NASA.

From the DoD level down, almost all the components in the drawing have some sort of relationship to each other. And through R&D contracts, all are related to the vast complex of industry and educational institutions supplying knowledge and hardware to the various projects. A new question mark is the role, as yet not clear, of the Director of Research and Engineering in the DoD, who reports directly to the Secretary of Defense. He is Dr. Herbert F. York, formerly the chief scientist for ARPA.

Except for the President, there is no central focus of *both* decision and authority.



National Space Effort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Up
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Margaret Mead, probably the best-known American anthropologist, famed for such studies as Coming of Age in Samoa, *and* Male and Female, *gave a brief talk at the recent Washington, D.C., meeting of the American Association for the Advancement of Science on the subject of preparing youth for the space age. She had discussed this theme in greater detail earlier in an article, published in* Parents' Magazine, *which is reprinted here with permission.*

Bringing Children Space Age

MARGARET MEAD

SINCE about the end of World War II, discussions of our future have settled into a sort of Battle of Overstatements. In this battle, one side forbodes atomic extinction, the reduction of man's dignity to insignificance, the creation of newer and more horrible forms of thought control, the deterioration or distortion of the human race through radioactive-induced mutation. The other side holds to a daydream of a permanently frozen future, in which station wagons twenty years hence will look like the station wagons of today and nothing will have changed except the style of television commercials.

In this battle of overstatement, the optimistic static side has won a limited victory. Most parents today want their children to be flexible enough to adjust to whatever may happen—but they definitely do not want anything to happen.

So in front of us stand our children in pigtails, in blue jeans, in sunsuits, in nothing at all as yet. We know more than any group of parents has ever known about feeding them, about protecting them from psychological traumas, about the importance of giving them a sense of security and self-confidence and a consciousness of being loved.

We know that, as a result, these children of ours will have certain strengths: Almost certainly they will be optimistic; they will believe that anything can somehow be arranged for, bought, made, or invented. They will have little fear that their present errors and incapacities need limit them in the future. When the necessity arises, they will learn a skill they do not have—they can, if necessary, learn the alphabet, or to add, fix a car, run a railroad, design a new machine tool. They believe that if people have been brought up right, have had the right parents, do not have any hard luck, and live in a country like the United States, they will be pretty good people. Crime, alcoholism, even treason are to be attributed to some fault in the way people have been reared. Everybody could be good and kind—given half a chance.

These are the assets of personality which happy and conscientious American parents can count on in their children. But what of the deficits? First, there is a tremendous lack of historical perspective about the world. While we have been training our children for the Here and Now, making them at home in their contemporary world, we have so

narrowed down their imaginations that they can conceive of no language but English as a real language—the others are "foreign" languages, seen vaguely as inferior translations. Tremendously sympathetic with the plight of other countries, willing to give and to help, our children are basically incapable of conceiving that any other way of life can compare with our own.

This is a deficit, and a correctable one; for never before have we had as rich and available materials for introducing children to the ways of life—the arts, the music, the dance, and the theater of other countries and periods. And we know of no other way to nourish the imagination about the future—which our children will need—than to open to them the panorama of the past where mankind has experimented in coats of many colors.

American children are unacquainted with tragedy. They live in a world where some people, inexplicably, have had bad luck—bad luck which never adds to the dignity of life but merely evokes pity for the self and for others. This gradual breach with a recognition of the tragic side of life comes understandably from our history, from the youth of the country, from the two World Wars in which our soldiers died on other shores but no one fell on our soil. It comes also from living in a period of such rapid medical advance that it almost seems as if death were somehow being banished forever, and the death of grandparents at sixty has come to be regarded as a misfortune which should not have to be endured.

People are now awakening to the dangers of this denial of suffering and to the need for children to have such awareness of it as will make them strong enough to face tragedy and to deal with the meaning of their own lives and the lives of others. So we can hope that young parents will find ways to bring their children gently back to a full acceptance of all aspects of their humanity. With a greater recognition and acceptance of death should come also a greater sense of athomeness with their own bodies—a kind of awareness that will stand them in good stead in encounters with new foods, in experiments with new drugs, on exploratory trips to the moon.

While we have been rearing happy, well-adjusted, unafraid children, we have lagged behind in creating conditions out of which come first-rate achievement in the sciences, in the arts, in politics. Children who are always active and occupied, who have lots of friends and get on well with the group, become people who work well in big organizations and apply knowledge that is already

known. Rarely do they contribute original thinking or unique achievement.

Understandably, we have rebelled against many of the conditions which bred first-rate achievement in the past—desperate, nightmare-ridden childhood, threats of eternal damnation, driving parental pressure to stay at the piano or at one's books. We would not, if we could, go back to the conditions which fostered gift and skill in the past, but we are in desperate need of new methods for the future. We have repudiated pain and punishment as goads, and we are perhaps the people best fitted to experiment with the possibilities of delight as motivation. Our lavish spending today for games and toys and the paraphernalia of a child's room is also quite sufficient to provide materials for solitary play in which the child's imagination can exercise.

At present, we are too dependent for our original thinking on the individual who has been accidentally isolated and who is, for this reason, often not able to function in a team. It's true that the methods of research and discovery on which the future depends are essentially team methods. Whether we think of the faculty of a school, the planning department of an industrial enterprise, the staff of a clinic or a hospital, the research projects of universities, or the operations of government agencies, these are all team projects today. Our present way of rearing children does prepare them to work on teams—but not to do the necessary individual work which makes it worthwhile to have the team.

We need more intended leisure and more experience of tolerated isolation for our children, and less expectation that they have a right to demand that adults find "something to do" and either do

it with them or find them playmates. It may be that "quiet hours" will have to be stylized—as the "meditation room" at the United Nations has been stylized—before we can handle easily the idea that a child can be quiet and alone and not be doing something he shouldn't. But certainly a greater capacity for solitariness combined with a capacity to enjoy and get along with other people will increase both our capacity to do original work and our ability to cooperate in international ventures with Europeans and Asiatics who are more accustomed to working alone than we are.

Another capacity we need to develop is an enjoyment of people of different ages and interests. We have graded our children very severely and have separated them into narrow groups, so they are often unable to enjoy children a year or so older or younger, to respond to adults and enjoy the old, or to make friends across a sex line which is not severely limited in age range. With new, large families becoming the mode and with fathers so much more at home, we have the possibility for a different model of companionship based on diversity rather than on similarity of interests. This can be another component in creating genuine teamwork and a greater ability to integrate and adjust in intense isolated projects, in international relations, in getting along on Antarctic expeditions, or on interplanetary explorations.

Still another place where we have let a pattern run away with itself is in boy-girl relationships where going steady has been allowed to invade the period of early adolescence, when adolescents should be learning to make friends of their own sex. Such friendships are a way for young people to discover themselves and to free themselves from overdominant parental images and standards. These friendships then become models for a different attitude toward the self and toward associates throughout life, and are a counterpoise to the demands made upon marriage. At present we are rearing children who will ask more of their spouses—in companionship, understanding, stimulation, criticism, and reflectivity—than any one individual can supply, and so we are putting a new strain on marriage at the very time when the new postwar style of happily shared parenthood is taking shape.

Finally, we are entering a world in which more and more of our living will involve processes which include machine links—whether it is buying a ticket, cashing a check, traveling, applying for a job, gaining entrance to a college, passing an examination, obtaining a security check, getting caught as a traffic violator, or ordering a spare part for some domestic gadget. Somewhere in every one of these and a thousand other aspects of everyday life, everything will depend upon the accuracy with which some task is performed: upon the turning of a screw, the copying of a number, the turning of a hole in an IBM card. Life will become increasingly like a parachute jump—something that has to be done right the first time.

The present generation of parents was reared when we were trying to free children from the burdens of punishment, anxiety, and compulsion—and they have also been left singularly free from any respect for accuracy. A new respect for precision—based not upon fear of punishment but upon a clear and vivid appreciation of the conditions under which things will work—is an essential requirement for an increasingly mechanized world. It is essential whether the machine is Univac, predicting the election correctly only if the right numbers are put onto the tapes that are fed in, or a plane delivering a minister of state for a momentous interview in another country, getting him there safely only if no single detail of the engine has gone uninspected.

Traditionally, Americans have reared their sons on the democratic hypothesis that any one of them might become President. Taken figuratively rather than literally, no one knew how far any given child, whatever the conditions of his birth, might go. Recently we have been shrinking away from this sense of infinite possibilities. If one discusses the possible exploration of the moon, one is faced with an audience who, while they may believe that somebody will explore the moon sometime, no longer think it might be one of their own children. Yet the world of the future must underwrite the aspiration and creativity, the statesmanship and courage for such ventures.

Just as we built this country on the assumption that anybody might be President, we need now to act as if any one of our children might reach the moon—so that everyone will be ready for the world in which the moon will be explored.—END

A longtime student of the cultures of primitive and modern societies, Margaret Mead is Associate Curator of Ethnology at the American Museum of Natural History in New York. Of late her interest in the impact of science on modern society has resulted in several articles and monographs in scientific journals and popular magazines, crowded into a busy schedule of teaching, lecturing, and research projects.

THERE'S MORE *to the universe* THAN MEETS THE EYE

HARLOW SHAPLEY

THE most important aid to the human mind in the understanding of the universe, both the microcosmos and the macrocosmos, is the electromagnetic spectrum, as currently exploited. The major part of our knowledge of the universe has in the past come through information provided by one sense organ alone—that of vision. Our eyes are, however, sensitive only in a small segment of the long radiation spectrum—they are sensitive from the violet to the red—much less than two octaves. But with a suddenness unequaled in the development by artifice of sense-organ spread we have now learned to explore nature with radiations extending over a range of more than fifty octaves, a range from the cosmic rays of less than a billionth of an inch in wave length, through gamma rays, X-rays, and the ultraviolet, up to the blue-to-red radiation our eyes record; and then from red to heat waves to radio and on to electric wave lengths measured in miles. We know and measure and use these off-color radiations not directly with the retinas of our eyes, as we do with light, but with artifacts, with the retinas, we might say, of photographic plates, Geiger counters, and photo cells.

The eyes and other sense organs arose naturally to serve animals in the practical problems of existence, not for use in profound researches into the nature and operations of the universe. Practical existence had not until recently included the thirst for "impractical" knowledge.

It happens that the range of human vision from violet to red covers that part of the radiation spectrum where the sun's light is most intense. In fact, there is not much solar intensity in the short waves of X-rays or the long waves of radio.

If there are animals with vision on a planet near a hotter, bluer star than the sun, for instance Rigel in Orion, they probably are more sensitive than we are to light in the bluer section of the spectrum; and near a cooler, redder star, like Betelgeuse, more sensitive to reddish light. Of course, our sun was not made yellowish just to suit our visual sensitivity! On the contrary, our vision has evolved to fit our star.

A fact worth emphasizing at this point is that man has no built-in sense organs for either long wave lengths or for those short-wave radiations that are more violet than the violet. He is blind except to a narrow range in the electromagnetic spectrum. If he had been outfitted from the beginning with sensitive recorders throughout all wave lengths from hard X-rays to long-wave radio, his

knowledge of the world might have differed vastly from that which he has slowly developed by way of his restricted vision. Earth waves, dark lightning, molecular motions—such phenomena might have long been in his commonplace book. To feed himself, to dodge or overcome his enemies, and to find his mate, he has had little need of the solar radiation with wave lengths like those that activate our radios; and since the atmosphere, as it has developed on the earth, has through its ozone blockage shut off the ultraviolet, he, as an animal, has also had no practical need for the short-wave end of the spectrum.

As an organism ambitious to know, and know deeply, he is rather primitive in his senses if not in sense. (Our primitivism in body anatomy is, of course, generally recognized.) Every human sense receptor, except possibly that concerned in tone discrimination, is outdone by the corresponding receptor of one animal or another—by the hawk's vision, the dog's hearing, the insect's smelling. Some stars have enormously strong magnetic fields; ours a weak one, and we have no recognized sense receptor for magnetism.

But these sensory limitations, and the resulting failure to comprehend fully much of nature, may be only a local deficiency. On the basis of the new estimates of the great abundance of stars and the high probability of millions of planets with highly developed life, we are made aware—embarrassingly aware—that we may be intellectual minims in the life of the universe. I could develop further this uncomfortable idea by pointing out that sense receptors, in quality quite unknown to us and in fact hardly imaginable, which record phenomena of which we are totally ignorant, may easily exist among higher sentient organisms.

Sometimes we suspect the existence of senses other than those we recognize in ourselves, among animal and plant forms on this planet—not merely extended ranges of hearing or of vision or smell, but entirely different responses. The bees and ants respond, as we do not, to polarized light; the birds in migration—to what? And there are those among us who dream of vestigial or embryonic [human] senses. . . .

Rather than dwell on these probabilities, let us note simply that anthropocentric religions and philosophies, which have so often been conspicuously earth-bound and much tangled up with the human mind and human behavior, have in these present days an opportunity for aggrandizement through incorporating a sensibility of the newly revealed cosmos. If the theologian finds it difficult to take seriously our insistence that the God of humanity is the God of gravitation and the God of hydrogen atoms, at least he may be willing to consider the reasonableness of extending to the higher sentient beings that have evolved elsewhere among the myriads of galaxies the same intellectual or spiritual rating he gives to us. A one-planet deity has for me little appeal.

You may say that these are but speculations, insecurely founded, and that you choose to believe and reason and worship otherwise. And I must reply that you should follow your inclination. But you are invited to think seriously of the cosmic facts. Let us hope that an easement is not sought in comforting tradition alone, or in resort to crude irrationality. The new knowledge from many sources—from the test tube, from the extended radiation spectrum, the electron microscope, experimental agriculture, and the radio telescope; from mathematical equations and the cosmotrons—the revelations from all these make obsolete many of the earlier world views. The new discoveries and developments contribute to the unfolding of a magnificent universe; to be a participant is in itself a glory. With our confreres on distant planets; with our fellow animals and plants of land, air, and sea; with the rocks and waters of all planetary crusts, and the photons and atoms that make up the stars—with all these we are associated in an existence and an evolution that inspires respect and deep reverence. We cannot escape humility. And as groping philosophers and scientists we are thankful for the mysteries that still lie beyond.

There are those who would call this attitude their philosophy, their religion. They would be loath, I hope, to retreat from the galaxies to the earth; unwilling to come out of the cosmic depths and durations to concern themselves only with one organic form on the crust of one small planet, near a commonplace star, at the edge of one of the galaxies. They would hestitate to retreat to that one isolated spot in their search for the Ultimate. May their kind increase and prosper! —END

Noted astronomer at the Harvard College Observatory, Harlow Shapley is the author of several works in the field. The selection above is excerpted from his latest, Of Stars and Men, *published at $3.50 by the Beacon Press, Boston, and is reprinted with their permission.*

THE WRITERS OF SCIENCE FICTION . . .

Prophets of the Space Age

ANTHONY BOUCHER

MAN TOOK his first step into space on October 4, 1957—a date which future encyclopedists are certain to rank above October 12, 1492, in the history of earth.

And just about the only people who were not amazed were the handful—maybe a quarter of a million—who regularly read science fiction.

Science-fiction readers have known that man has had the scientific knowledge and technical ability to leave this planet for over a decade. It's been essentially a matter of time, money, effort; so there was nothing inherently surprising in its final accomplishment. . . .

This isn't, of course, the first time science fiction has been years or decades in advance of the news headlines; but people forget fast, and have mostly forgotten already how impressed they were a dozen years ago by science fiction's foreknowledge of the atomic bomb.

There was, as you may have heard, one classic incident when the FBI cracked down on a science-fiction magazine for publishing the secret of the A-bomb—a secret which was at that time known to nobody except the workers of the Manhattan Project, a few Communist spies, and anybody who could understand prewar technical articles on nuclear research. . . .

The story in question was *Deadline,* by Cleve Cartmill, and it appeared in *Astounding Science-Fiction* for March 1944—a year and a half before the general public had ever heard of atomic fission. . . .

Cartmill was one of the best writers in what was probably the best science-fiction period yet (the early Forties), but this time he wrote—as can happen to any of us—a real clinker. It takes place on the planet Cathor (location and time unspecified) and is about a war between two forces named, with all the subtlety of Serutan, Seilla and Sixa. Our hero, Ybor Sebrof, is a Seilla agent sent into Sixa to destroy a bomb invented by their top scientist. He has troubles with the beautiful leader of the underground ("He was male . . . put together with an eye to efficiency; and she was female, at the ripening stage") and gets into the power of the scientist (who at least is not mad). When all seems lost, Ybor "whipped his short, prehensile tail" (which has not so much as been hinted at—unless by that obscure reference to male efficiency—in the preceding 9,000 words) around the barrel of Dr. Sitruc's "gun" and everything comes out OK.

We—the science-fiction readers of 1944—read this and shuddered. One letter to the editor described it as "mediocre fantasy." And when we came to the passage that perturbed the FBI ("Now the explosion of a pound of U-235 . . . releases as much energy as a hundred million pounds of TNT; two cast-iron hemispheres, clamped over the orange segments of cadmium alloy . . . the powdered uranium oxide runs together in the central cavity. The radium shoots neutrons into this mass—and the U-235 takes over from there"), we thought, "Oh Lord, another atomic-bomb story! Cartmill usually comes up with fresher ideas than that!"

Which was the point that John W. Campbell, Jr., then as now editor of *Astounding,* made to the FBI agents when they suggested a cease-and-desist order on stories about A-bombs. Atomic energy, for peace or war, was already a commonplace of science fiction. *Stop* writing about it and you'd give enemy agents the perfect tip-off that a genuine A-project was under way.

For what matters, as concerns the prophetic nature of science fiction, is not so much the occasional on-the-nose exactness as the broader education of the reader, inducing him to take advanced concepts for granted before their existence is suspected by the general public, or sometimes even by scientists.

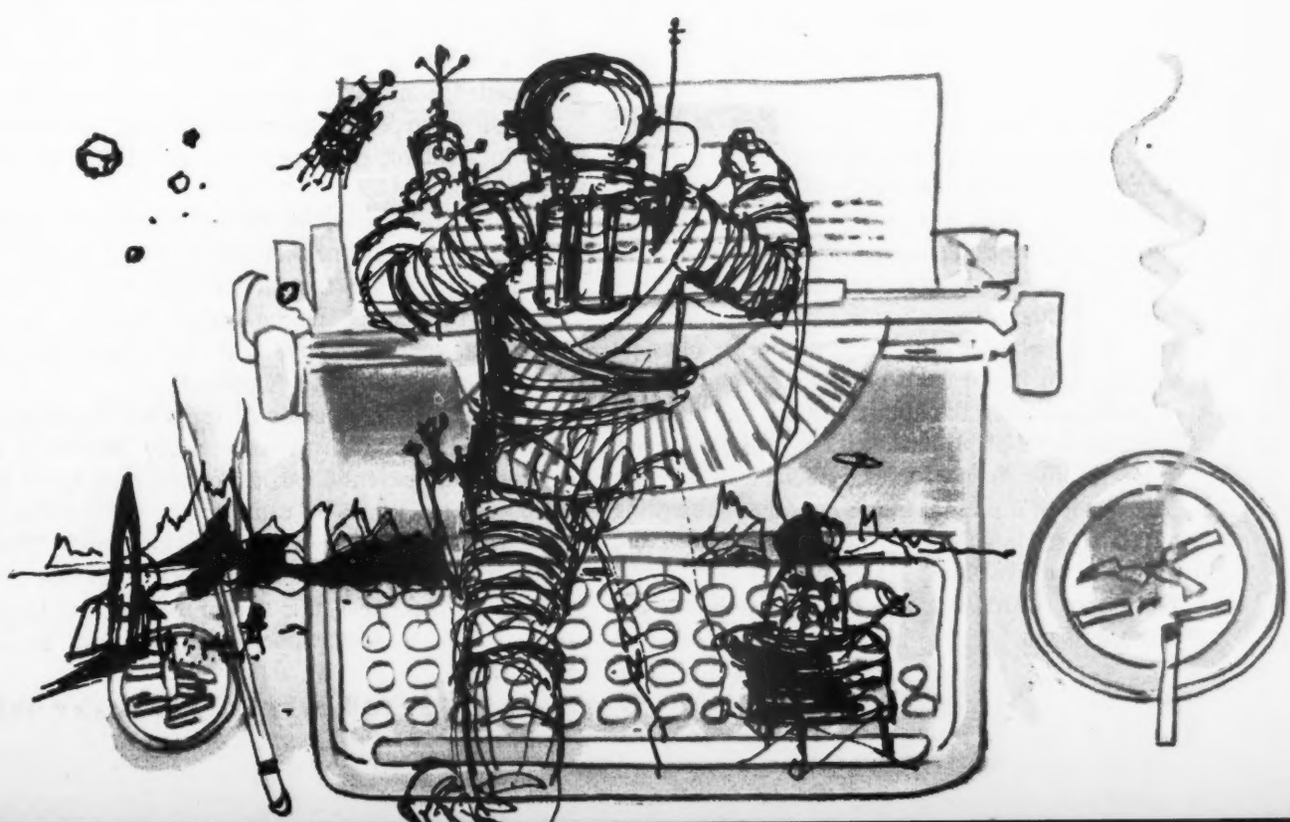
A good example is this very theme of the earth satellite, which goes back in fiction the best part of a century, to Edward Everett Hale's *The Brick Moon,* serialized in *The Atlantic* in 1869 and 1870. Hale's moon was, as far as accuracy goes, terrible. Its material, its means of projection, its equipment—nothing about it would work. But it did establish—in fiction, long before it was ever discussed as a factual project—that a man-made moon could be put in an orbit around the earth and that much scientifically valuable data could be drawn from observing such a satellite.

The frequency with which the prophecies of science fiction come true is the result of at least three factors. The simplest is that by now science fiction has prophesied so very many, often mutually contradictory, futures that it's getting harder and harder for reality to come up with anything that hasn't been set down in fiction some time, some where. Fire off enough prophetic shots and some of them are bound to hit the bull's-eye . . . and you can afford to disregard the ones that don't. For instance, no matter what the surface of the planet Venus (which is hidden from our observation by permanent clouds) turns out to be like, from a water world to a desert, there'll be a science story which has in advance described it exactly—and usually on the basis of statements by orthodox astronomers, who also believe in the shotgun method of speculation.

Of course, not everyone can be so lucky as Jonathan Swift, who in 1726 had Lemuel Gulliver meet astronomers who had discovered that Mars possessed two small moons (in 1877, by what Willy Ley has called "the purest coincidence known to the history of science," Asaph Hall discovered that Mars sure enough *does* possess two small moons). But a certain number of random guesses are bound to turn out to be "prophecies," purely by the odds.

Then a large number of science fiction's accurate hits come about because writers and scientists (or technologists or manufacturers) are thinking along the same lines. Fastest example of fulfillment I know: In 1953 Ann Warren Griffith sold *The Magazine of Fantasy and Science-Fiction* a story, *Captive Audience,* about a miniature sound device which could be inserted in products so that they would continuously give off their own commercials, drawing the poor consumer's attention to their yummy goodness. Even before the story could be printed, Miss Griffith walked into a supermarket and was assailed by a jar of prunes equipped with a miniature sound device which, etc. . . .

The use of available but publicly ignored material accounts for science fiction's successes



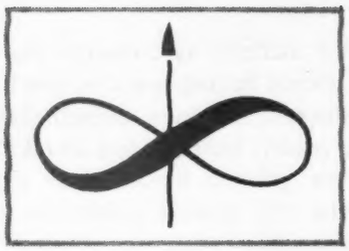
with the A-bomb, as well as with peacetime atomic power (it was as far back as 1942 that Lester del Rey wrote the still impressive short novel *Nerves,* about the medical aspects of disaster in an A-plant), and now with the preliminaries to spaceflight.

And this same method should have enabled us to foretell Russia's head start into space. In 1941 I was writing a mystery novel (*Rocket to the Morgue*) for which I needed a great deal of factual background on the history, past, present, and future, of rocket research. At that time there existed precisely one popular book (P. E. Cleator's *Rockets Through Space*) in the English language on rockets and spaceflight. Counting privately published volumes and highly technical works, there had been five books published in English on the subject.

At the same time there had been eighteen such books published in German . . . and thirty-one in Russian! Willy Ley, the leading German (and now American) historian of rocketry, tells me that thirty years ago he was forced to teach himself to read Russian; there was no other way of getting at much of the most important theoretical writing. Konstantin Eduardovich Tsiolkovsky (1857-1935) was unquestionably a world pioneer in ideas for using rocket propulsion to conquer space—and was far more recognized and honored after the revolution than before.

All these data were available—plus such items as the Russian announcements of a projected space platform three months before our much-publicized satellite announcement in 1955—and some science-fiction writer should have had the prophetic sense to write a serious story of the Russian space pioneers—though partial credit must go to Steve Benedict for hinting at Soviet moon conquest in his *Stamp from Moscow* (1953), if only as a caprice. But we goofed . . . probably because the Russians have claimed so many "firsts" that we don't believe them even when, as with Tsiolkovsky, they have an authentic one.

Some of the science fiction's most frighteningly accurate prophecies have been, not in the physical sciences, but in the fields of sociology and history —and often when the author's intent has been the exact opposite of prophecy. It's a common device in imaginative fiction to write about a future that *could* happen if present trends continue, presenting it as a Horrible Example, with a prayer of "God, let it not be like this!" *Brave New World, 1984, The Space Merchants, On the Beach*—all typify this approach.



In 1914 Arthur Conan Doyle wrote a short story, *Danger!,* explaining how England could be starved by the then unheard-of device of a submarine blockade. The admiralty thought the story foolish until the Germans instituted just such a blockade in World War I.

In 1915 Edgar Wallace—who, like Doyle, wrote occasional science fiction along with his mysteries—published a novel called *1925: The Story of a Fatal Peace,* in which Germany loses World War I but is tolerantly allowed to rebuild her military establishment until she is in a position to start the whole thing over again.

And back in 1907 Jack London wrote one of the all-time masterpieces of political prophecy in *The Iron Heel:* a precise step-by-step analysis of the coming of fascism, the economic and social reasons for its invention, and the methods by which it would gain power. London's only serious error was in placing the phenomenon in America rather than Europe.

The hoped-against may turn out to be true prophecy; the hoped-for may prove to be false. Farthest from the target of any political prophecy yet made is one in Cartmill's *Deadline:* that the A-bomb would be developed by the Axis (or Sixa) because "we, the Seilla," though having the knowledge and skill required, "would not dare to set off an experimental atomic bomb" for fear of its incalculable damage to the world, present and future.

The most interesting cause of accurate prophecies, however, is neither luck nor well researched thinking; it is the fact that science itself is influenced by science fiction—often directly, sometimes at such a remove that the scientist himself may not know what's happening.

I. M. Levitt, director of the Fels Planetarium of the Franklin Institute, recently published an earnest ultrascientific article on the opening of the Space Age. When he came to the possibilities of going beyond the solar system, he wrote: "Now the scientist begins a bizarre speculation that puts even the science-fiction writer behind the times. . . . Cold-minded, sober scientists have an in-

genious solution"—which turns out to be the familiar science-fiction cliché of the "Noah's Ark of space," the ship which is a miniature world in itself, self-sustaining and self-perpetuating, so that the remote descendants of the original crew make planetfall centuries after the launching. This idea appeared first (as far as I know) in Don Wilcox' *The Voyage That Lasted 600 Years* (*Amazing*, October 1940) and received its definitive treatment in Robert A. Heinlein's *Universe* (*Astounding*, May 1941). It's still with us in fiction—at least three stories on the theme appeared in the past year. Yet a scientist can, with no notion of its history, advance it cold mindedly and soberly as a new idea beyond the reach of science fiction.

But the influence of science fiction on science is usually more direct. In 1897 Kurd Lasswitz, a mathematics professor at Gotha, published a novel called *Auf Zwei Planeten* (*On Two Planets*) which contained, among other attractions, the earliest detailedly accurate working out of the orbital problems of spaceflight. This ponderous but popular novel exerted great influence on actual German rocket research. Most of the members of the German Rocket Society (*Verein fur Raumschiffahrt*) were Lasswitz devotees who had been first attracted to space activity by this novel. These *Verein* members were the same men who went on to become the rocket experts of Peenemünde, who developed the V-2, and who were later divided, almost as spoils of war, between Russia and America. . . .

In addition to nine technical works, the Russian writer Tsiolkovsky wrote a novel of spaceflight, *Vne Zemli* (*Beyond Earth*), which was his most popular book and the first to be reprinted after the revolution. There's no doubt that it's as familiar to Russian rocket enthusiasts as the Lasswitz novel is to Germans, or that the present German-assisted Russian space program is to a large extent a deliberate realization in fact of the science fiction of Lasswitz and Tsiolkovsky.

Among American scientists there is, of course, the "cold-minded, sober" type that will have nothing to do with any idea published outside of a professional journal; but the younger men, the scientists and engineers actually engaged on the projects of the future (such as atomics and spaceflight), are almost invariably readers of science fiction—and often took up their careers out of adolescent passion for the future depicted in the bright-covered magazines. Every science-fiction publisher knows that his largest per capita sales will be near universities with a major physics department (Cal Tech, MIT, California, etc.) or in highly classified government projects (Oak Ridge, Hanford, White Sands, etc.).

You know waldos? Those tiny remote-control mechanical "hands" that are used to manipulate radioactive material? They're named after the title character of Heinlein's *Waldo*, who invented them in 1942—and inevitably so named because everybody working with them was almost automatically a Heinlein reader.

From here on out in the Space Age, the prophecies of science fiction may be fulfilled with even greater frequency, because space will be conquered by men who are steeped in those prophecies.

You will find in today's science fiction—particularly in the work of such realistic-imaginative writers as Heinlein or Clarke—the step-by-step account of that conquest: from small satellites, such as the Sputniks and the Explorers, to a large habitable space station; thence to the moon and its conversion into a yet larger way-station to space; on through the exploration of our nearest neighbors, inhospitable Mars and unknown Venus, to the eventual complete knowledge of this small solar system and ultimately (in one of science fiction's most worn but still thunderous phrases) To The Stars—perhaps by the almost-as-fast-as-light photonic drive on which Russia is now working, and which has long been familiar in fiction.

Science fiction's sternest and most persistent prophecy of the immediate future is this: a species which has attained atomic power and spaceflight can no longer afford the luxury of national and racial rivalries, but must unite or perish. "There are no nationalities beyond the stratosphere," writes Arthur C. Clarke in *Prelude to Space* (1951). "We will take no frontiers into space."

Which may well prove to be the most tragically incorrect of all of the prophecies of science fiction.—END

The author, Anthony Boucher, a veteran practitioner of the prophetic writing he describes, is editor of the Magazine of Fantasy and Science Fiction *and mystery book reviewer for the New York* Times. *This article was originally called "Wizards of a Small Planet" when it appeared in the May 1958* Playboy, *from which we have condensed it with the author's and the magazine's permission. From* Playboy: *Copyright 1958 by HMH Publishing Co., Inc.*

CONGRESS TAKES A HARD LOOK AT THE SPACE LAG

Spelled out painfully in the January 11 report of the House of Representative's Select Committee on Astronautics and Space Exploration was the frightening US lag in space technology—estimated by some experts to be as high as five years. The report, given wide and deserved notice, warned of the survival stakes involved in a scientific rout by the Soviets. Reprinted here are important excerpts from this significant document. Space considerations alone preclude our reprinting the full text of this report.

NATIONAL space policy in the United States, to be effective, will inevitably require the greatest partnership in the history of civilization and government. Industry, business, government, invention, and law, charged with spiritual motivations and enriched by the nation's educational resources, must join in this project because mankind has never before been confronted with possibilities so hopeful and so awe-inspiring. . . .

It cannot be overemphasized that the survival of the free world—indeed, all the world—is caught up in the stakes. Outer space is fast becoming the heart and soul of advanced military science. It constitutes at once the threat and the defense of man's existence on earth. Only a bold and dynamic program employing the total talents and the greatest strength of the United States and its friends is competent to meet a challenge so overwhelming. . . .

If we are unprepared, we may be swept away. At best, our situation is dangerous. It finds us vulnerable not only to the threat of nuclear, chemical, and biological war, with space employed as a medium of attack, but to the more subtle and equally threatening danger which lies in moral, psychological, and political fields.

It is possible, with foresight and skill, to master these tremendous changes. But nothing short of a national effort by all those armed with power, ability, and devotion can guarantee safe navigation of the swift currents of change which are now coming into view. Success is almost certain to mean unparalleled progress for tomorrow. Failure, as the history of the complacent, wealthy, and unresponsive nations of the past attests, very probably points to a new Dark Age. . . .

As this report and its supporting staff studies will show, every phase of modern life is somehow bound up with the new space technology. This fact poses two questions:

(1) Will the United States move steadily to marshal the resources of the free world and ensure that no threat of force from space will be able to control or destroy us?

(2) Will the United States provide the leadership to unite the world in dedicating its space capabilities to peaceful purposes? . . .

This commiteee is pleased with what has been done [by the US] so far. But it is also concerned whether this is enough. It has worked to see that the Congress fully appreciates the stakes that are involved. The committee is also concerned whether the Executive Branch is driving home to the public the realities we face in a way which will create the broad-based support needed for carrying on a national effort of the magnitude we require.

We would not preach alarm for the sake of sensationalism, nor counsel despair. But we would not gloss over the difficulties and the dangers which lie ahead of us. Presenting a fair balance requires the most careful attention to policies of public information by the committee, the Congress, the Executive Branch, and others in a position to influence the public. True technical secrets which are of military value should not be

given away, but the public must be told enough to understand in general where our nation stands in this important race. Neither successes nor failures should be overblown for the sake of immediate sensation, if our own public and the world at large are not to be left in a state of confusion and doubt. What is needed is an appreciation of the immensity of the job and the time requirements. But also the public must understand that a *sustained* effort is required now. . . .

The government of the United States, including the Congress, during the coming year must come to grips with many serious problems related to space. . . .

Need for the Program

1. *We are in an age of rapid technological change wherein the strategic balance of power can shift to the nation first achieving operational usability of new scientific developments.* Neglect of new development may create a time of weakness for a nation, long enough for a strong rival to overwhelm and destroy it.

2. *The effects of technological advance can be of compelling force, even without resort to war.* Military strength-in-being shapes the behavior of all nations through its very existence. In the political and psychological struggle, when more than one nation has great military power, scientific leadership of itself can win respect and support from other nations. This means that policies encouraging the growth of science and technology must be viewed in terms of their effect both on direct military power and on the struggle for world leadership in political, psychological, and cultural terms.

3. *It would be highly impractical not to face the reality that space technology, like nuclear energy, can be used for war as well as for peace.* The United States is dedicated to ensuring that outer space be devoted to peaceful purposes for the service of all mankind. The Eighty-fifth Congress voted such a resolution, and this has been the stand of our delegates before the UN. Scientific knowledge itself is neutral; the men who use it determine its results for good or evil. . . .

The United States must continue to strive for conditions which will make it possible for all space research to benefit mankind. But this effort is meaningless unless such striving is accompanied by an American and free-world effort to develop space devices of the highest order of versatility. Failure to do so would deny the free world not only the peaceful benefits of space, but also the capability to detect hostile moves against these nations (including the violations of agreements) and the ability to counter such threats. . . .

4. *The military potentialities of space technology, which the United States would prefer to see channeled to peaceful purposes, are greater than general public discussion to date suggests.* Military space capabilities are technically inseparable from peaceful capabilities which are well worth pursuing in their own right. Reconnaissance for merchant-ship lane patrol and for peaceful mapping of resources can also be used to locate military targets. Communications to improve global relations can also be used to control military forces. Rockets for cargo and passenger delivery can also carry thermonuclear weapons. Satellites designed to return men from an orbit to a preselected point can also deliver bombs.

5. *The decision to undertake a space program cannot be made in the context of domestic conditions alone.* Whether the United States undertakes such a program or not, the Soviet Union has already launched a massive program with considerable momentum. The Soviet effort has a long record of study and popular and governmental interest behind it. The Soviet program has been vigorously pursued since the time of World War II, and has been assigned a high priority of scientific manpower, materiel, and coordinated organization. Soviet leaders implicitly believe that they will be the first to explore outer space. . . .

6. *A key question is the relative position of the Soviet space accomplishment as compared with that of the United States.* There is no clear-cut answer to this question, but enough is known beyond all possible doubt to cause grave concern and to require positive action. . . .

- Several qualified witnesses before this committee have estimated the Soviet over-all lead over the United States as twelve to eighteen months. This estimate may be overly generous to the United States, considering that the Soviet effort in ballistic missiles has been continuous since 1946, while the American effort did not intensify until after the thermonuclear warhead became a strong possibility in 1955. If the gap is twelve to eighteen months, the implication is that the United States will be capable of putting equally large useful payloads into orbit at as great average distances above the surface of the earth as the Soviet Union did by the first half of 1959, or not long thereafter.

- Moreover, the critical measure is not the

time gap between Soviet and American space capabilities but the time required to close it. Even if the Soviet rate of progress is no greater than that of the United States, the gap would never be closed, but would progressively widen (owing to the greater absolute magnitude of the present Soviet effort). This prospect cannot be accepted with complacency, considering the implications it carries for the ultimate survival of the nation. One dispassionate, long-term student of space technology, an important research institution, estimates that if the United States attempts a strong, thoroughgoing effort, it will take at least five years to close the gap. This prediction is of extreme significance to national planners.

Nature of the Program

1. *Inventions cannot be scheduled in advance.* Solutions to known problems can be sought by organized attack upon them, but frequently key discoveries providing solutions or shortcuts or entirely new possibilities show up with but little warning in quite unlikely circumstances. Experience with attempts to put thermonuclear energy to peaceful use also shows that a solution may lie tantalizingly just outside our grasp, with no real measure of how soon success can be achieved. This means that (a) mere setting of a timetable and appropriating money will not automatically permit us to achieve certain important goals; (b) programs must be flexible enough to take advantage of scientific breakthroughs when they occur, both as to direction of development and rate of expenditure.

2. *Crash programs are the most expensive kind to undertake.* Money cannot buy back all the time which has been lost by neglecting a foreseeable need. The appearance, refinement, and testing of technical ideas inevitably requires a certain time lapse. Even where lead times can be compressed to a degree by use of overtime, and by starting production activities while design is still in a state of flux, there results a cost in diversion of resources from other worthwhile projects. It also creates the chance of irrevocable commitment to faulty designs, undue waste later in attaining operational reliability, and a wear and tear on key individuals. . . .

3. *The early design-study phase of research is relatively cheap in money, but it may not be cheap in amount of time required.* If certain deadlines are important to national security in years ahead, it is a blunder to save moderate amounts of money in the first years by neglecting the research phase, when no amount of money will buy back the time later.

4. *To start-and-stop programs is the most expensive and dangerous way to undertake them.* A program should maintain a certain momentum. Institutions, whether governmental, industrial, university, or private research, must be able to hire staffs and acquire equipment in the reasonably firm knowledge that a program once started will be seen through except for compelling reasons; and they must not be in the position of hoarding scarce technical personnel on a mere outside chance that they will acquire programs. In a nation where individuals count, the men on scientific and engineering teams must be given some semblance of security in their jobs and personal relations, some stability for their family arrangements, if they are to devote their wholehearted interests to R & D projects. . . .

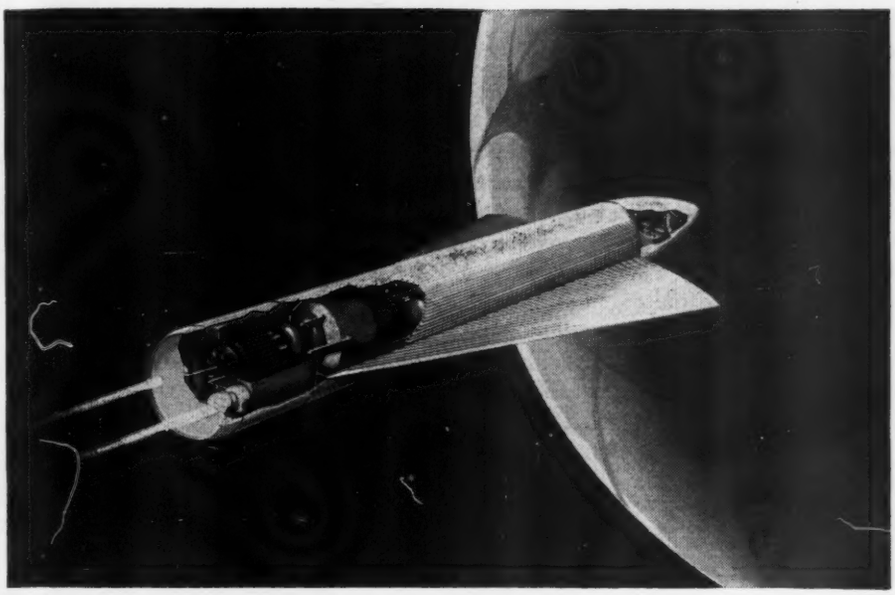
5. *The pace of development has been so rapid, as new devices make earlier ones obsolete, that we are pressing hard against the limits of fundamental human knowledge.* The development of a number of apparently practical devices is held up by the need to attain more basic knowledge first, a process which is hard to hurry, hard to direct, that takes time, but that comparatively speaking does not take as much money as the final work of production.

6. *At the same time that the arrival of new developments is occurring more and more frequently, the complexity of many of these projects is growing so that their planning requires programming of efforts over a longer span of years.* Such long-range planning involves reconciling our traditional practice of appropriating money year by year with the funding (subject to safeguards) of certain important programs over a number of years. In a sense, this is done when required in the fields of natural resources and public works. It should be possible in space exploration.

7. *Long-range flexible planning should entail approval of programs which are not yet certain in every detail and a system of followup and reappraisal leading to program revision when necessary.* In both respects, the process of decision apparently requires improvement. Testimony before congressional committees is eloquent on these points.

COUNT DOWN!

for the conquest of space



ROCKETDYNE ENGINEERS HAVE MADE MORE THAN 50 TRIPS TO THE NEIGHBORING PLANETS

Through the ship's viewing port looms a breathtaking sight—a gigantic red crescent spanning some 30° of deep black sky. A television camera, passenger on this strange new chariot, stares intently at a sight never before seen by man and beams home to Earth his first crude view of the planet Mars.

From dream to drafting board

Less than a decade will pass before this age-old dream of man is realized. Bold steps toward such an exploration of Space are underway now. An experimental ion rocket engine will soon be placed in operation at Rocketdyne's Propulsion Field Laboratory in the Santa Susana mountains. From this research tool will come design data for the efficient, low-thrust freight engines for Outer Space. These engines will be capable of operating for months at a time, and will make possible extended reconnaissance of the Solar System and detailed studies of the phenomena of Space.

But what of the journey itself?

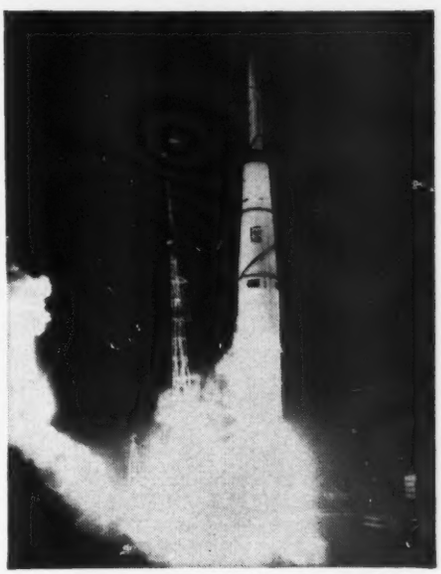
Rocketdyne engineers have made more than 50 trips to the neighboring planets on huge computer machines. In these paper trips, they have studied the gravitational effects of as many as seven planets at a time. By watching closely the effects of such forces on their low-thrust ion vehicle they determined thrust programs to reach various planetary objectives. They showed the trip to Mars could be made with thrust to vehicle-weight ratios as low as 1 to 10,000.

Testing in Space conditions

Rocketdyne has been at work on ion rocket engines since 1955. While many difficult design problems yet need to be solved, extensive new facilities and three years of exhaustive studies are being applied to the job. Rocketdyne scientists will operate their experimental ion engine in simulated space conditions to unlock important answers to thrust chamber design, power conversion systems, nuclear heat sources, and propellants.

Hardware for defense and science

Today the operating hardware in the field of high-thrust rocket engines is designed and built by Rocketdyne: propulsion systems for the Air Force's Atlas and Thor, and the Army's Redstone and Jupiter... and for scientific missions such as the Explorer satellites and the NASA space probes conducted by the Air Force and Army. Based on this unequalled experience, Rocketdyne is already probing far into the future. Engineers are already at work on the next and succeeding generations of high-thrust rockets, and high-specific-impulse engines to supplement chemical rocket performance.



PROBING TOWARD THE PLANETS
Heaved bodily into Space by the Rocketdyne-powered Thor first stage, the Pioneer starts on its 80,000 mile sortie toward the moon.

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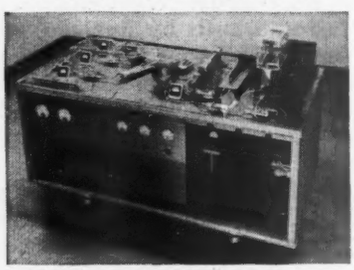
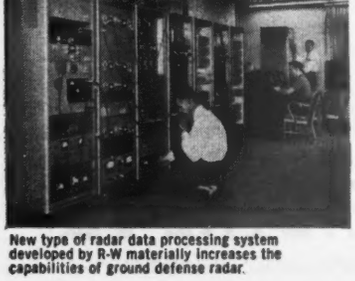


Ramo-Wooldridge is responsible for advanced electronic sub-systems development for application with both current and projected missile programs

Important infrared "search and track" equipment is now being developed by Ramo-Wooldridge for applications in modern U.S. Military aircraft

R-W is one of the major participants working with the Boeing Airplane Co. Systems Management Office on the U.S. Air Force Dyna-Soar project



New type of radar data processing system developed by R-W materially increases the capabilities of ground defense radar.

While it is now a division of **Thompson Ramo Wooldridge Inc.** instead of a separate corporation, **Ramo-Wooldridge** remains an integrated organization for research, development, and manufacture of electronic systems for military and commercial applications. R-W's military work is covered by thirty-four contracts with the Army, Navy, Air Force, and other government and industrial organizations. These support a broad technical and—in some cases—manufacturing program in such varied fields as Electronic Reconnaissance and Countermeasures; Microwave Techniques; Infrared; Analog and Digital Computers; Air Navigation and Traffic Control; Antisubmarine Warfare; Electronic Language Translation; and advanced Radio and Wireline Communication.

In the commercial field, the well-known RW-300 industrial process control computer and associated equipment—the basis of the expanding business that **The Thompson-Ramo-Wooldridge Products Company** is doing with process industries—was developed and is manufactured by the Ramo-Wooldridge division.

Men, machines, and manufacturing know-how from other TRW divisions will be added as needed to build up the growing production strength of the Ramo-Wooldridge division. In other ways, too, the availability of the special skills and facilities of the rest of the corporate family will broaden the services R-W can offer to its customers. However, R-W's major systems work will continue to be done in an organizational framework that brings the engineering and manufacturing groups into close-knit project teams in the division's own integrated development and manufacturing facilities in both Los Angeles and Denver.

Ramo-Wooldridge is production-oriented in the sense that its end objective is the manufacture and sale of equipment. However, because of the highly technical nature of its product lines, the R-W division will continue to give unusual emphasis to maintaining a high degree of professional scientific and engineering competence.

The RW-300 digital control computer has broad applications in automatic process control, data reduction and test facility operation

Systems are being developed for the ground processing and interpretation of photographic and other data collected by aerial reconnaissance devices

The Military and Ramo-Wooldridge are studying the use of automatic data processing techniques

In research laboratory studies at Ramo-Wooldridge, electrically-charged particles are contained and supported in a vacuum by an alternating electric field

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Policy Implications for the Space Program

1. *Inexorable changes in society and political power will follow the development of space capabilities; failure to take account of them would virtually be to choose the path of national extinction.* Space developments already have changed the course of world history as inevitably as the discovery of America changed the history of Europe. The space challenge must be met by the adaptability, the energy, and the vision of the American people. Informed citizens, progressive business managements, and the organs of government, including the Congress, must understand these facts, create public awareness, and act decisively in their respective fields to put this scientific knowledge and space capability to practical use. This must be done with sound and understanding cooperation—particularly, in the field of government, between the legislative and executive branches.

2. *What program the United States could achieve and what it will in fact achieve may be two very different things.* This committee is releasing under separate cover a comprehensive and significant review of what the United States could accomplish in the next ten years, foretelling the effects of scientific forces now in being. It deserves to be read with care. . . .

3. *Budget pressures in the short run should not be the primary basis for decisions on space programs which are inherently long range, and which involve the very survival of the nation. . . .*

4. *This nation should not make inadequate short-run expenditures on its space program at substantial risk to its survival a few years later.* The American people prefer economic and fiscal stability and soundness, but must view them in long-run terms.

5. *The best advice obtainable by the committee supports the view that within a decade peaceful applications of space development to weather prediction and long-range communication alone will more than pay back to the economy all the funds previously required to achieve these capabilities.* Six satellites could handle the entire overseas mail volume of the world, as the Atlas satellite has already demonstrated in rudimentary form. Better weather predictions are expected to save the US economy about $4 billion a year.

6. *The greatest benefits of space development and exploration in all probability cannot even be predicted today.* This has been true of countless past discoveries. . . . What may come in resources, in understanding of the forces of nature, in solving many of the present mysteries of life may be beyond all immediate human understanding. This is not the kind of challenge man can safely ignore.

7. *Although engineering secrets related to national defense deserve the utmost protection, the greater part of the space program will progress more rapidly without the shackles of an undue security control. . . .* Compartmentalization of research findings, within a narrow, need-to-know framework whether done in the name of national security or to protect proprietary interests, can only slow up our progress. Free exchange of information among scientists and engineers is particularly important for a country which is making a late start in developing its space capabilities.

8. *Full scientific and technical cooperation among the nations of the free world is essential to their joint survival and to the fastest growth of the American space program. . . .* The space program will soon reach such size that it will require the combined effort of many nations. It is our hope that the exploration of space will in time absorb the friendly common efforts of all nations. In the meantime the free world cannot afford to delay its own space development on a united plan while waiting for improved relations with the Communist bloc.

9. *Scientific education in the United States stands in need of critical review.* No phase of the soul-searching produced by the launching of the Sputniks excited a more sympathetic response from an alarmed people or from educators and legislators than the realization that American education had failed to measure up to the needs of the hour. . . .

As this committee concluded the meeting at which this report was adopted, the news of the Soviet lunar probe became public. This committee has been consistent during the year of its life in believing that the Soviet Union has a distinct lead in astronautics over the United States, although it also believes that with time and toil the United States can surpass the Soviet achievements. Many prominent Americans, however, have minimized the Soviet advantage at various times during the year. The latest Soviet achievement proves the soundness of the view of this committee that our scientific race, not alone in space but in the broader realm of science, is . . . urgent and demands the utmost effort by this nation.—END

Speaking of SPACE

RAND Report on Space

Bombing is feasible from satellites, moon bases are a definite possibility, Russia's rocket capability is the result of a longtime, well-thought-out program that had its theoretical roots in the ideas of Konstantin Tsiolkovsky, ideas spelled out even before the airplane had really gotten off the ground.

These are just some of the space-age points made in the fascinating and highly readable "Space Handbook: Astronautics and Its Applications" prepared by RAND Corporation for the House Select Committee on Astronautics and Space Exploration and released January 9. RAND, a nonprofit organization which performs research for the Air Force at Santa Monica, Calif., outdoes itself in providing legislators and the public with an understandable compendium covering almost every aspect of astronautics.

Just a partial list of subjects indicates the scope of the report. Covered are the space environment, the moon and planets of the solar system, trajectories and orbits, principles of rocketry, structures and materials, communication and tracking, a survey of present programs, the possible uses of satellites, and the history of astronautics, with special attention to the USSR.

An interesting commentary on popular, but weakening, view that the Russians stole most of their scientific capability is contained in one passage from the report:

"Realizing the enormous military potential of the rocket, the Soviet government had organized, by 1934, a government-sponsored rocket-research program—only five years after Germany had embarked on its rocket program but eight years before similar systematic Army-sponsored research began in the United States. Stalin's personal interest in the development of long-range rocket-propelled guided missiles is discussed in the book *Stalin Means War,* by Col. G. A. Tokaev, formerly chief of the aerodynamics laboratory of the Moscow Military Air Academy, who defected from the Soviet Zone of Germany to Great Britain in 1948."

One particularly frightening point is made in the discussion of the uses of atomic bombs in space. The report says that since space is a relatively perfect vacuum the radiation effects of nuclear explosions would spread out much farther, minus the absorbing air of the terrestrial atmosphere.

Other points made in the report:

NASA Administrator T. Keith Glennan (left) and James S. McDonnell, head of McDonnell Aircraft, examine model of Project Mercury space capsule.

- Although there is no direct confirmation of a Chinese Communist operational space program, the Chinese Communists are cooperating with the Soviets in satellite observation.
- The Soviet Union launches space vehicles from the Kyzyl Kum Desert, some 250 miles southeast of the Aral Sea.

In addition to the excellent informative text, the report is illustrated with charts and drawings.

House Space Committee Reports

The RAND report and several others of the House Space Committee reports are being published by the Government Printing Office, and will be available from the Superintendent of Documents, Washington 25, D. C. The RAND report will sell for sixty cents. The Government Printing Office has not established prices for the others, listed below:

"International Cooperation in the Exploration of Space," released October 15, 1958.

"Survey of Space Law," "The International Geophysical Year and Space Research," and "Summary of Hearings on Astronautics and Space Exploration," all released December 22, 1958.

"The United States and Outer Space," released January 11, 1959.

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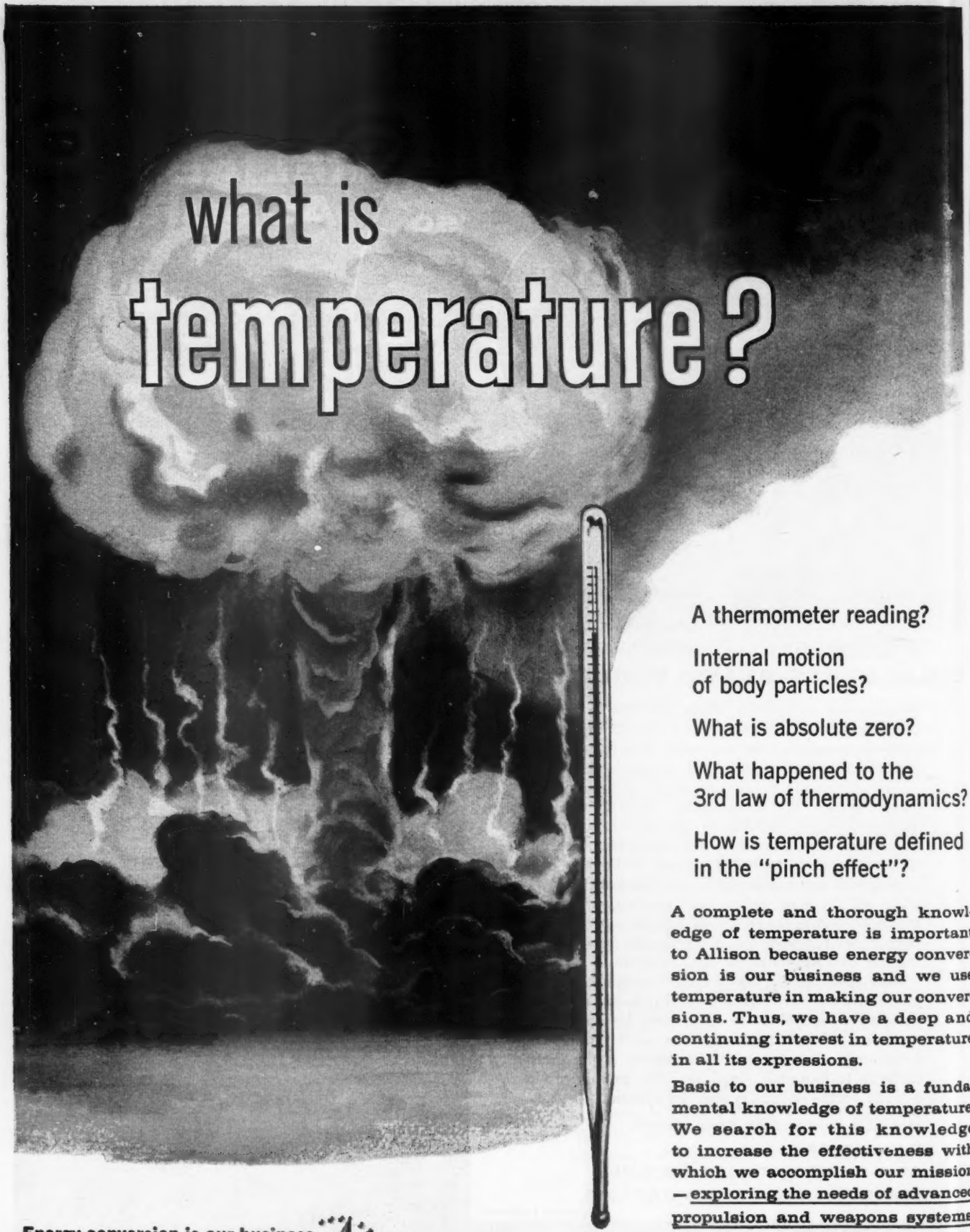

A thermometer reading?

Internal motion of body particles?

What is absolute zero?

What happened to the 3rd law of thermodynamics?

How is temperature defined in the "pinch effect"?

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AAAS Meeting in Washington

Space technology earned headlines at the year-end meeting of the American Association for the Advancement of Science, held in Washington. Two distinct bands of radiation ring the earth, Iowa University's Dr. James Van Allen told the AAAS, reporting on data analyses from the Pioneer III lunar probe. Between the two radiation bands, Dr. Van Allen indicated, is a fairly low-level "buffer zone"—where shielded spacemen at altitudes of about 6,000 miles could safely orbit. The first intense band, data suggests, extends from approximately 1,400 to 3,400 miles out at latitudes near the equator, and the second "hot" belt is at altitudes of from 8,000 to 12,000 miles, extending to higher latitudes. At around 25,000 miles, radiation intensity seems to fade to very small comparative levels. Biggest question now is the exact nature of the radiation. Protons would produce far greater intensities than electrons.

State of the art in preparing man for space operations was also reviewed by experts at the AAAS meeting. Indications continue to be that man will be able to withstand the accelerations and heat stresses to be expected from launch and reentry. Real knowledge of such items as recycling air, water, and food through the use of algae or other exotic systems needs much more research, scientists reported. As one said, today's knowledge is "scratching the surface of scratching the surface."

Two Lockheed Missiles System Division space scientists, Saunders B. Kramer and Richard A. Byers, described to the meeting of the American Astronautical Society, held in conjunction with the AAAS meeting, a space station design they believe feasible in the next ten years. The station would be a 400-ton wheel assembled from cylindrical compartments twenty feet long by ten feet in diameter and equipped with automatic coupling devices. The pieces would be put together by spacecrews operating from "astrotugs" launched into orbit. Men would not have to leave the astrotugs (themselves designed to support two or three for a week) but would hook up station parts using automatic "arms" extending from their protective vessels. Orbit altitude would be 500 miles out.

Help Wanted: Satellite Squelcher

Our space scientists not only have to figure out how to get satellites up and out and track them, but must begin to worry about how to bring them down again, or at least how to quiet them. For example, the Vanguard, launched March 17, 1958, is still sending out signals at 108.03 megacycles, twenty-four hours a day, and is expected to stay in orbit for about two hundred years. During the last year Vanguard has sent back valuable scientific information about the temperature it encounters, about its own orbit, and indications of the exact shape of the earth it passes over. But scientists are now speculating about the time when it may be expedient to turn off a satellite's radio or even pull it back to earth as more sophisticated devices are developed to replace it. Among the current suggestions are such devices as a slow-growing potato that could be placed in the satellite to eventually shut off its switch—or the possibility that among the first men in the manned space patrol would be a satellite catcher—a man with a net, going around picking up old satellites.

World Wide Photos, Inc.

NASA's Hugh Dryden, left, presents AAAS Spaceflight award to University of Iowa's James Van Allen as Lt. Gen. Roscoe C. Wilson, center, looks on.

GEORGE "MOON" MEYERS—By Jack Tippit

"I know it sounds funny, Meyers . . . but this radiation allergy you picked up is actually hayfever."

Long-range Debate

About the time Lunik became Mechta and went into orbit around the sun, an enterprising correspondent of the Capetown, South Africa, weekly *Landstem* telephoned Anatoli A. Blagonravov, who seems to be the man most-likely-to-be-interviewed in the Soviet Academy of Sciences. The Afrikaans weekly said that Mr. Blagonravov told its correspondent that the next step by Soviet scientists would be to "launch a scientist in a planet to at least 400 miles above the earth."

"He will travel on an exactly similar path to the man-made planet that has now passed the moon," said Mr. Blagonravov.

"The man will have control over the planet and will be supplied with water and food in tablet form. He will send coded radio messages back to earth if anything goes wrong and he is unable to return." Blagonravov was also quoted as saying that the Russians expect to land a probe on Venus and Mars in June, and will follow this with manned rockets.

In rebuttal, back in London, Dr. Richard Woolley, Astronomer Royal, who is described as being a sceptic about space travel, offered his advice on the situation: "If they [the Soviets] get to Mars, they will find it freezing cold. If they get to Venus they will find it is boiling hot. On neither planet will they be able to breathe. The best of luck to them."

A Card for Every Occasion

Among the congratulatory messages received by Rear Adm. John Clark, Deputy Director of ARPA, on the day the Atlas orbited was a gleeful card from the youngsters in his Alexandria, Va., neighborhood. A standard "get well" card, it read: "Glad to hear you're up and about!"

Progress at Kitt Peak Observatory

A. B. Meinel, reporting on the progress of the National Astronomical Observatory at Kitt Peak, Ariz., in a recent issue of the *Astronomical Journal,* tells us that there are at present two excellent sixteen-inch photometric telescopes, and modern living quarters housed in a quonset building. Bids have been received for construction of a thirty-six-inch telescope which should be in operation by October of this year. Engineering is proceeding on the eighty-inch telescope, and casting of the eighty-four-inch ribbed Pyrex mirror is under way. The eighty-inch telescope should be ready by December 1960.

An Unsolved Problem

Professor John C. Cooper, emeritus of International Law, McGill University, who gave serious consideration to the question of international airspace long before most of us realized the extent of the problem, discusses the situation further in the January 1959 issue of *Flying* Magazine. He traces the history of "airspace" in international dealings, defines the terms and agreements, lists the current proposals, and leaves us with the strong impression that this is an area in which we must proceed with caution, but firmly.

Omens of Destruction

Philosopher Bertrand Russell, in his new book *Common Sense and Nuclear Warfare,* offers grim possibilities for the future if too-militant scientists occupy the moon and the less hostile planets. The eighty-six-year-old scholar and mathematician predicts:

"There may be a war, as a result of which all or nearly all will perish. If there is not war, there may be assaults on heavenly bodies, and it may well happen that means will be found to cause them to distintegrate. The moon may split and crumble and melt. Poisonous fragments may fall on Moscow and Washington or on more innocent regions. . . . I hope, though with much doubt, that some gleams of sanity may yet shine in the minds of statesmen. But the spread of power without wisdom is utterly terrifying."

Yes, but more terrifying would be lack of courage to respond to the challenge of exploration.

Notes from Hollywood

The hour-long 16-mm. television films done by Frank Capra, "Our Mr. Sun" and "Hemo the Magnificent," are available for purchase or for free loan from local offices of the sponsoring Bell Telephone System.

Walt Disney's "Man in Space," a thirty-five-minute 16-mm. film, and

"Our Friend the Atom," which lasts fifty minutes, may be leased from Walt Disney Productions, 16-mm. Division, 2400 Alameda Ave., Burbank, Calif.

Pentagon R&E Chief

Dr. Herbert F. York was appointed Director of Defense Research and Engineering on December 24. The thirty-seven-year-old scientist had been Roy Johnson's chief scientist for the Advanced Research Projects Agency of the Department of Defense. Dr. York, born in Rochester, N. Y., received an AB and an MA in Physics from the University of Rochester. He worked on the electromagnetic isotope separation program at the Y-12 plant, Oak Ridge, Tenn., received a Ph.D. in Physics from the University of California, and worked for UCAL's research program. In 1954 he was director of the UCAL Livermore Laboratory. Dr. York came to Washington in March 1958 with the Institute for Defense Analyses. He is presently a member of the President's Science Advisory Committee.

Dr. Herbert York

Interagency Council

President Eisenhower has appointed Dr. James R. Killian, his special assistant for science and technology, to head the new Federal Council for Science and Technology which will act to promote closer coordination of government research and strengthen the nation's over-all scientific effort. Creation of such a council was recommended by the President's eighteen-man Science Advisory Committee in a report submitted in late December. The report also stated that US science "has a scope and depth unequaled anywhere in the world." However, it continued, "Too often, starts and stops and changes in research programs have thrown the national effort off balance and have damaged morale in laboratories vital to the national defense and well-being." The committee was especially critical of the present emphasis on material as distinguished from research activities.

"While difficult to prove, there is little doubt that a more vigorous support of basic research . . . over the past decade would now be paying rich dividends in making 'things' easier and less costly to develop. It would also minimize the need for expensive crash programs." What is needed, the committee concluded, is not more money for research, but wiser use of existing funds.

Satellites in a Spin?

Prof. R. N. Bracewell and O. K. Garriott of the Radio Propagation Laboratory of Stanford University, Calif., writing in *Nature*, a British weekly journal of science, suggests that some phenomena of the signals received from Sputnik I indicate that the satellite might be rotating about its centroid. This possibility is discussed and the rotational method of satellites of different shapes is analyzed. By feeding out, under centrifugal force, a small mass in the form of a very long fine thread of strong material, the moment of inertia could be increased by a substantial factor, they suggest, and the spin velocity accordingly reduced.

Speech Briefs

Maj. Gen. Marvin C. Demler, USAF Director of R&D, to the ARDC Symposium on Molecular Electronic, November 13, Washington, D. C.: ". . . we are not exploring space to satisfy our thirst for knowledge alone. We are driven to it by a greater need, which is to insure our very survival. To succeed, we must excel in technological skill over those who would seek to destroy us. . . . In support of our national objectives . . . the next decade will require . . . a continuing advancement in the aircraft and missile technology. Electronics must keep pace with this progress."

T. Keith Glennan, NASA Administrator, at Wright Day Dinner, Wash-

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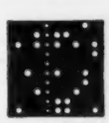

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SPEAKING OF SPACE

ington, D.C., December 17: ". . . we have only started to appreciate the magnitude of the tasks facing us. . . . There is need to lay out a long-range program calling for the acquisition of basic scientific information and the development of the technology necessary to this mission. Such a program would include an orderly attack on a broad front including astronomical, geophysical, meteorological, and similar basic areas of knowledge. . . . orderly programs in these basic areas must be planned, scheduled, and undertaken."

Lt. Gen. Roscoe C. Wilson, Deputy Chief of Staff for Development, USAF, before the American Astronautical Society, December 27, 1958: "In the past the capability of the Air Force to gain control in the air—in theaters of military operation—has made possible the freedom of movement of friendly forces on the lands and seas beneath, in addition to providing a wholly new medium of warfare.

"In the future the capability to maintain the initiative in space will permit freedom of movement on the surface of the earth and within the atmosphere and even into the interplanetary or more distant regions.

"In the past we have insisted on the freedom of the seas, and I feel that the free nations of the world will insist on freedom of movement in the space regions. The exploration of space should be for peaceful purposes and for the betterment of mankind."

For the Record

The seventeenth Convair Atlas SM-65 was successfully launched from Cape Canaveral, Fla., on December 23, last year. This, the first firing of the C series Atlas, probably had a lighter payload than earlier versions. This was the seventeenth Atlas firing in just over a year, and was reported to have been a successful 4,300-mile flight.

Science and Morality

"From the point of view of the moral responsibility of the scientist a special, perhaps unique, problem arises in that science has put at the disposal of a few men a power which is truly devastating. In the past man's influence for good or ill was generally fairly localized. It is not so today. What is the right thing to do may be more important than the means by which it is done. The truly great scientist must be more than a technician. He will be called upon to advise the statesmen in certain immensely acute problems and, therefore, he must have a broad training as well as strong and sound moral principles.

" 'Two things fill the soul with awe,' said Emmanuel Kant, 'the starry heavens and man's accountability to God.' "

From a sermon, December 28, 1958, by the Right Reverend Monsignor William J. McDonald, Rector of the Catholic University of America, during the AAAS meeting.

Heads Together Across the Sea

Known as the Institute for Strategic Studies, Ltd., a new group has been formed on an international basis to study defense and disarmament. It will have headquarters in London, with its first director Hon. Alastair Buchan and its secretary Cmdr. H. E. B. Jenkinson, RN (Ret.). Its first three years have been financed by a grant of $150,000 from the Ford Foundation in New York. Although the founding members are all British, the Institute's purpose is to study the entire subject of strategy and security, and its membership will not be confined to Britain.

Adult Education—Basic Space

The Maryland section of the American Rocket Society and the University of Maryland have set up a Space Education Institute through the College of General Studies, University of Maryland, College Park, Md. The space education program for the next semester will be a series of nine lectures on space and its implications for our society. The series will be given every Monday night, beginning March 2, from 7:30 to 9:30 p.m. in the Enoch Pratt auditorium, Franklin Street, Baltimore, Md. It is open mainly to school teachers and members of the ARS, although interested adults may register.

Scheduled to speak on timely subjects are: Addison M. Rothrock of NASA; George Trimble, Jr., the Martin Company; Kurt Stehling, NASA; Col. John Stapp, USAF; Capt. Gray-

Working headgear for Motorola design engineers

From the arctic to the tropics... from jet altitudes to submarine depths... Motorola design engineers wear headgear matching the varied military applications of Motorola electronics. Working side-by-side with the Army, Navy and Air Force end user, these engineers provide technical assistance and, in return, gain first hand operational knowledge. The result—an understanding of user problems reflected in the design maturity of Motorola's military electronics systems.

And as for the many hats, those shown above have been worn on these representative programs: **A** *Integrated Battlefield Communication* **B** *Supersonic Rendezvous and Station Keeping* **C** *High-speed Tank Range Finder* **D** *Test Range Microwave Relay System* **E** *Ballistic Missile Radio Inertial Guidance System* **F** *Shipboard Surface-to-air Missile Guidance* **G** *Member, Army Scientific Advisory Panel* **H** *DEW Line Air Defense Radar* **I** *Strategic Bombing Radars* **J** *Amphibious Landing System* **K** *Shipboard Air Defense Data System* **L** *Tactical Drone Guidance.* For data on how Motorola's military experience can be applied to your problem... or for detailed information on engineering career opportunities... write to: Motorola, Inc., Military Electronics Division, Dept. A, 8201 East McDowell Road, Phoenix, Arizona.

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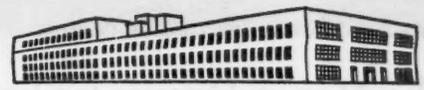

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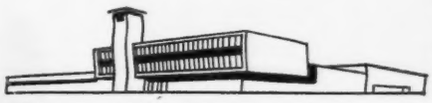

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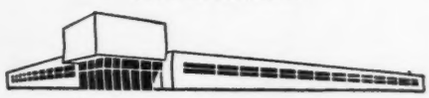

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The world's largest radome, measuring sixty-eight feet in diameter and more than seven stories high, has been designed and built by Goodyear Aircraft Corp. for the Missile Detection Systems Section of General Electric's Heavy Military Electronics Dept., under USAF contract. The huge structure, made of hundreds of interchangeable panels, can be erected by a six-man crew in eighty hours.

SPEAKING OF SPACE

son Merrill, USN (Ret.); Martin Summerfield, Princeton; Dr. Peter Castruccio, Westinghouse Astronautics; and Dr. Glen Blaugh, University of Maryland. The lectures will be taped, and copies of the series will be available next summer.

Atlas Expanded

USAF has contracted with the Convair Astronautics Division of General Dynamics Corp. to design and build an upper stage for the mighty Atlas ICBM. The new stage will contain a high-powered rocket engine under development by Pratt & Whitney to enable the Atlas to boost a payload into escape velocity. The Atlas without the upper stage is capable of lifting a payload of 2,500 pounds to orbital velocity. The additional power could launch as much as five tons into low orbits of one to two hundred miles' altitude, or might be used to probe space as far as Mars or Venus. The two-stage Atlas, although contracted for by DoD's ARPA, will be made available for NASA's exploration program, and could be the vehicle used in Project Mercury to orbit a manned satellite.

Bibliographic Checklist

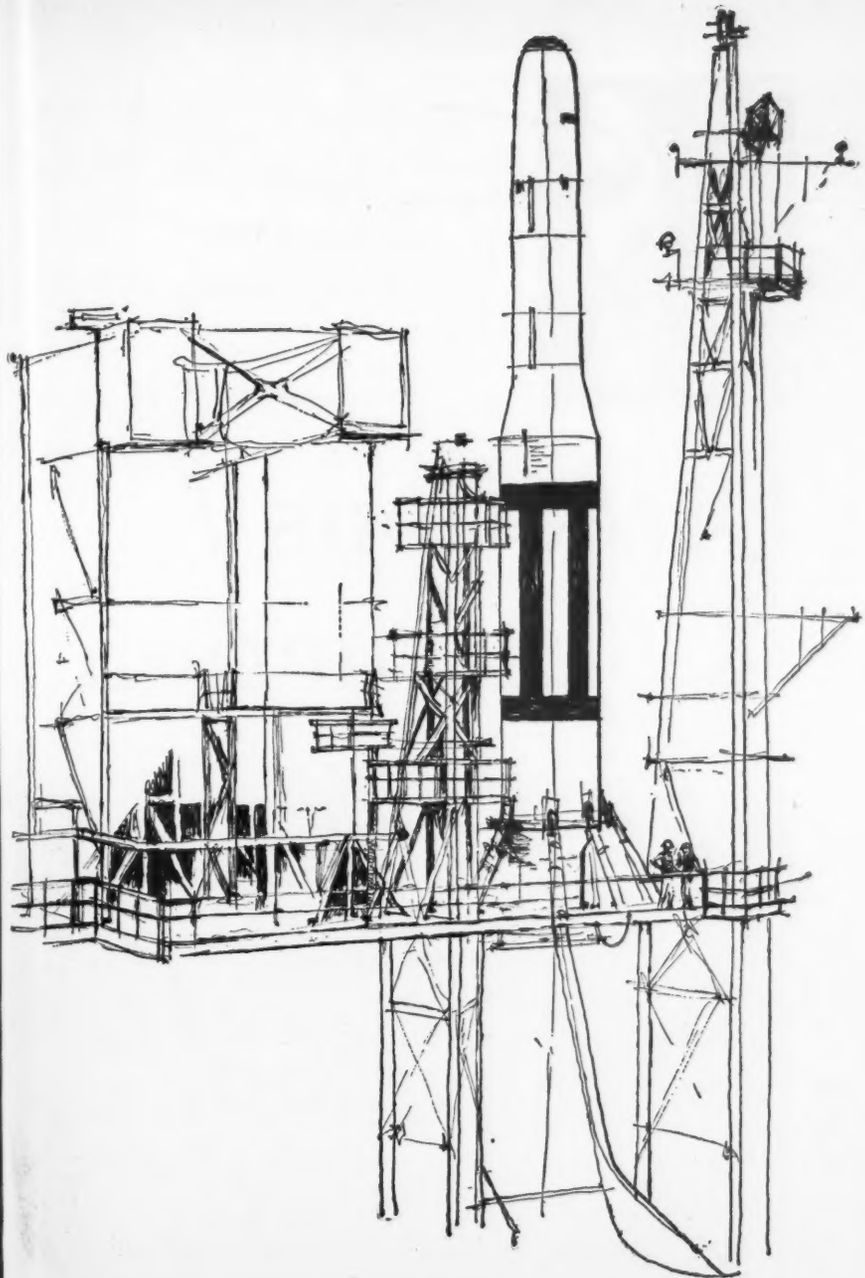
"Serial Publications of the Soviet Union," compiled by Rudolf Smits, 1958, 459 pp., $2.75, for sale by the Superintendent of Documents, Government Printing Office, Washington 25, D. C. Lists all serial publications known to have appeared in the USSR in 1939 or later. Gives Library of Congress holdings and call number of each publication and indicates other American and Canadian libraries having the serials in their collections. A subject guide to the serials and an index to corporate headings used are included at the end of the volume.

Children, Science, and Sir Snow

C. P. Snow, in the preface to the new edition of *The Search*, a novel about science and scientists, speaks a strong word for more scientific experience in general education:

"All children have a dash of the scientist in them. Watch any bright child if you tell him about the stars or atoms or dinosaurs. He will want to find out some more. The urge to in-

There is nothing else like this under the sun. It is the Martin-Denver facility, birthplace of the Air Force TITAN. It is also this country's most advanced and fully integrated big-missile development center. Here, our most formidable weapon systems of tomorrow are being designed, built and tested—from the smallest component to the total system—within a single 7,000 acre complex. Every top military and scientific expert who has seen Martin-Denver from *within*, considers it one of our most valuable national resources.



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vestigate, which is the scientific urge, isn't anything very special or academic. It is one of the most human things about us." Snow, who happens to be a scientist and a writer, deplores the customary distance between the two groups, and has made his early book available again in the hope that nonscientific readers will learn more of what it is to be part of the scientific world.

Moon on View

Sky Publishing Company, publishers of Harvard College Observatory's astronomical magazine, *Sky and Telescope,* offers Moon Sets, eighteen pictures showing the entire face of the moon, made from the excellent Lick Observatory negatives of the first and last quarters. Each print is 8½ by 11¾ inches with a white border. Small key charts are provided for identification of lunar seas, mountains, and craters. Moon Sets, mailed in heavy tubes, are suitable for framing. A bargain at $3.

Also available, a lunar map, for twenty-five cents and a Lunar Crescent Set, $2.50.

Address Sky Publishing Co., Harvard College Observatory, 60 Garden St., Cambridge 38, Mass.

On the Space Calendar

February 23-24: Canadian Aeronautical Institute special meeting, fiftieth anniversary of powered flight in Canada, Queen Elizabeth Hotel, Montreal.

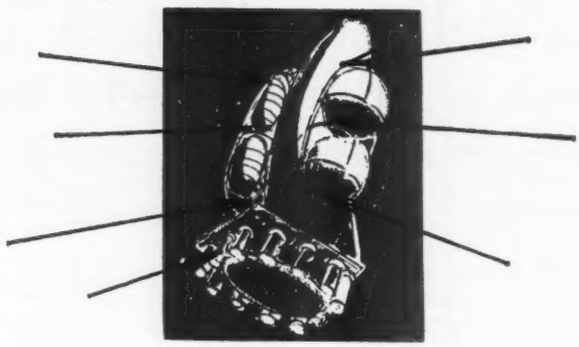
March 5-7: Western Space-Age Conference and Exhibit, Los Angeles Chamber of Commerce, 404 South Bixel St., Los Angeles, Calif.

March 31-April 5: International Committee of Military Medicine and Pharmacy, Twenty-first Session, Paris, France.

April 6-7: Air Force Office of Scientific Research, Third Annual Astronautics Symposium, Sheraton-Park Hotel, Washington, D.C.

April 30-May 1: American Rocket Society Controllable Satellites Conference, Kresge Auditorium, MIT, Cambridge, Mass.

August 31-September 5: Tenth International Astronautical Congress, British Interplanetary Society, at Church House, Westminster, London, S.W. 1.—END



New Directions for Space Construction

A summary by David Godfrey, A.F.R.AE.S., M.I.A.S., of "Structure and Material Problems" by Richard V. Rhode and John C. Houbolt of the National Aeronautics and Space Administration, presented at a recent Advisory Group for Aeronautical Research and Development discussion on "The Impact of Space Technology on NATO Research and Development."

FOR spaceflight vehicles the trend of structural development over the past two decades has been toward structures of increasing density.

Ultimate design stresses have increased, and more efficient structural designs have been developed. Latterly, aerodynamic heating has forced changes in structural geometry to reduce thermal stresses, and in more advanced cases materials of construction have had to be changed and special measures for insulating and cooling have had to be considered.

The trend is expected to continue for many applications, but structures of very low density now also have to be given much attention. The thin-wall construction of liquid-fueled rockets is an example. The potentialities lying above the present upper limit of the "flight corridor" should be exploited. Finally, for pure space applications with no aerodynamic forces present, low-density pressurized structures have already attracted some attention.

For space vehicle design, one guiding principle is emphasized even more than in aeronautical design: to keep weights low. This fact becomes strikingly clear when cognizance is taken of the fact that under the present state of rocket development it takes from 200-1,000 pounds of initial weight to put one pound in orbit. The severity of the problem becomes evident when it is realized that much structurally useless material may have to be carried along to provide heat and radiation protection for manned vehicles; furthermore, questions of reliability are of increased importance because of the lower density structures that may be involved.

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Stavid Project Engineer, W. L. McCULLOH, has 10 years' experience in the development of airborne electronics, including: X and S-band Beacons, Radar Toss Bombing, Airborne DME and ranging and coding circuitry.

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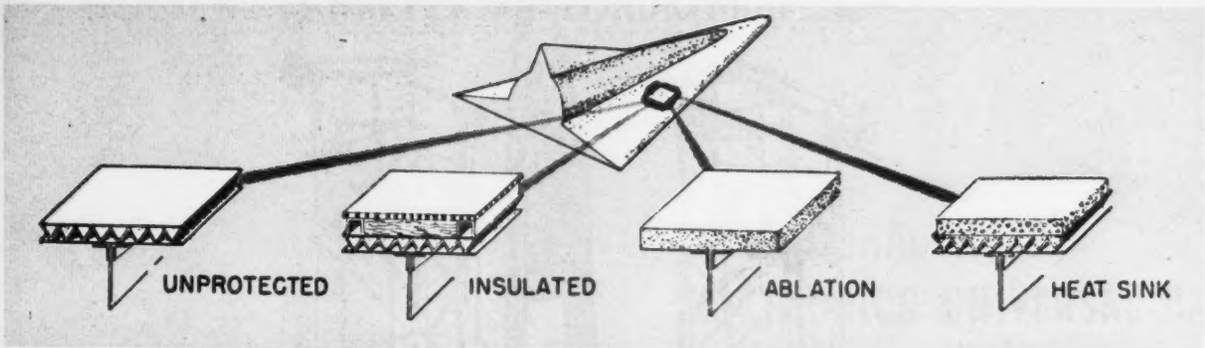


Heat handling methods: The unprotected method, governed by ability of vehicle to radiate heat away; the insulated structure in which the inner area is cooled by insulation; the ablation method, where heat is absorbed by dissipating expendable material; the heat absorbing "sink."

In the design of a heat-resistant structure separate consideration will usually have to be given to the surface areas and the leading edges. For the surface areas there are basically four types of construction that lead to a heat-resistant structure. One approach is that of an unprotected structure represented by a sandwich skin of high-temperature material. Structural temperature in this case is governed mainly by the ability of the structure to radiate away much of the incoming heat that is developed by convective boundary-layer heating; the heat capacity of the skin enters only in a secondary manner.

Considerable work has been done on the development of such structures and, in marked contrast to previous design experience, there are now instances of low aspect-ratio wings where the structural engineer can provide a thinner lifting surface than required for aerodynamic reasons, at a saving in weight.

The remaining approaches are basically methods either to block or absorb a portion of the heat input to limit temperature rise. One of these approaches involves the use of an insulated or "heterogeneous" structure in which the inner-load-carrying structure is kept cool by an insulation which, in turn, is kept in place by a heat-resistant (radiation) outer shell.

Another scheme, the heat sink, involves simply the use of a thicker structural skin in order to obtain the desired heat capacity to absorb heat. In this case the heat capacity of the structure can be raised by the incorporation of materials of high specific heat, such as beryllium, or by the addition of a coolant.

The fourth approach, which is known as ablation, makes use of an external layer of material which absorbs heat as it is consumed; alternate schemes for this case may involve sweat (evaporation) cooling.

The unprotected and insulated approaches are best suited for continuous flight application, and therefore seem most appropriate for manned reentry considerations. The heat-sink and ablation approaches apply mainly to those cases in which there is a very high influx of short duration and these approaches therefore appear naturally best for ballistic-type reentry.

There are also four basic schemes for use in leading-edge design. As with the surface structure, either the heat-sink or ablation principles may be used, or as alternatives, the leading edge may be given a protective coating of refractory material, or it may be kept cool through means of mechanical cooling devices. These cooling schemes may involve either the use of a circulating coolant or the use of a gas or fluid which is ejected through slots.

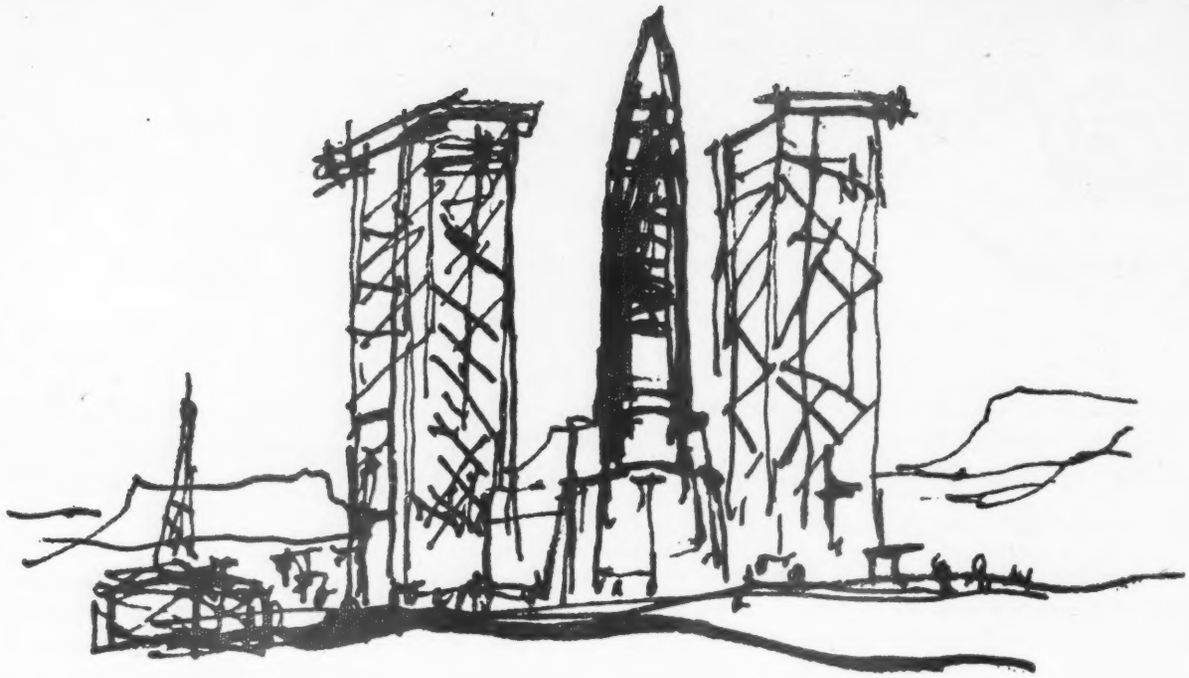
Although certain concepts of construction seem quite clear, additional research is needed to provide guide lines to help the structural designer in selecting the most efficient structural approach for the mission of his particular vehicle.

Structural Analysis Methods

The trend towards low-density type structures for space vehicles seems clear, and to give an idea of the resulting structural problems that require increased attention, the following four are cited:

- Buckling strength of very thin shells.
- Prediction of failure modes and general instabilities.
- The determination of temperature distribution, thermal stresses, and thermal deformation.
- Efficient design of structural joints.

The buckling strength of thin shells is strongly



influenced by initial imperfections. Consequently, the buckling theories for such shells always had to be modified by empirical reduction factors. Recent studies have, however, demonstrated the beneficial effect that may be achieved by use of internal pressurization.

Not all applications will be able to use pressurization. Serious gaps still exist in the unpressurized or partially pressurized regions, and these gaps are widening in scope because the shells now being built or contemplated have proportions outside of the range of previous experience; the radius/thickness ratio, for example, may be two to three times as large as those previously encountered. This change will lead to a substantial loss of strength; experiments are necessary to establish buckling values for this new range of proportions. In addition, the effects of various forms of stiffening on the local buckling of the less dense cylindrical structures have to be considered.

At the present state of knowledge it is seldom possible to calculate with reasonable accuracy the failure modes, strength, or probability of failure of complex structure, and the uncertainty is expected to increase as the structure becomes less dense, or as high heating rates are introduced. Substantial increase in research work on these aspects is therefore needed.

Another severe problem is that of calculating the temperature distribution, thermal stresses, and thermal deformations in the complex structures that will have to be used. While simple in concept, the procedures become very complex when put into practice.

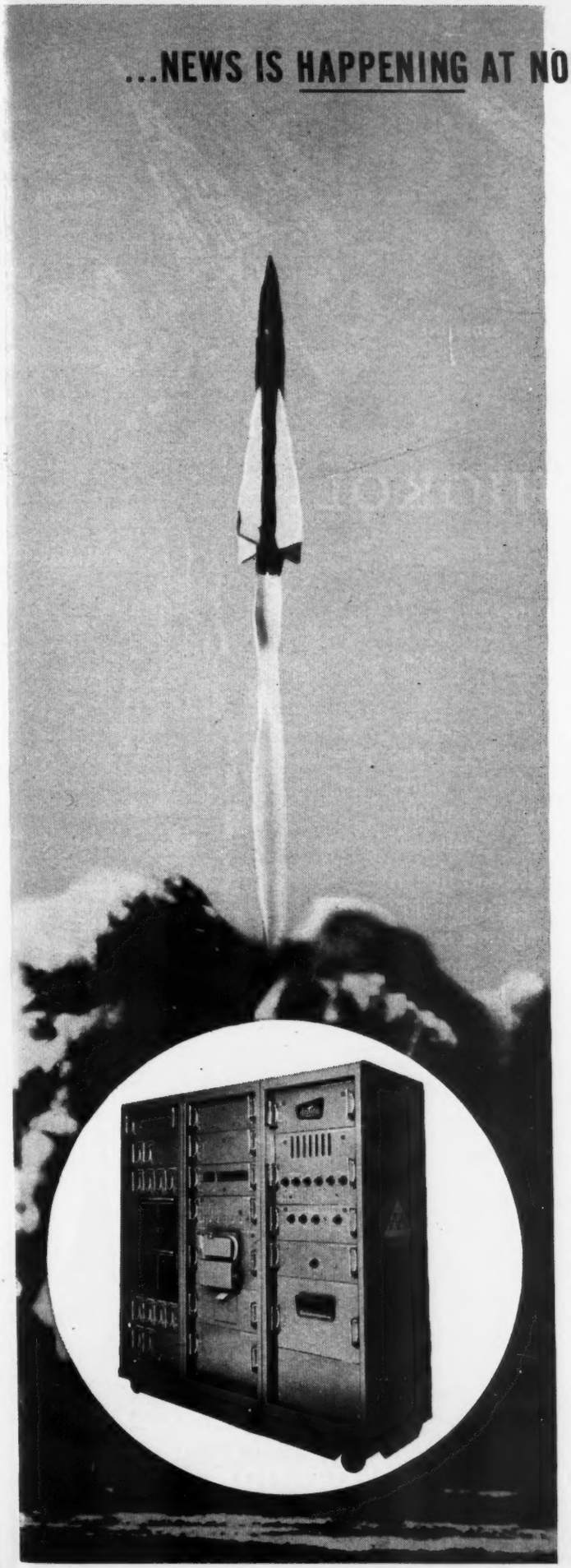
Structural joints are responsible for a substantial decrease in the efficiency of structures. Additional information is needed on the resistance to failure of various joint configurations. This problem has become of particular importance because of the necessity of attaching additional material of widely different physical make-up for heat protection, and because realistic consideration must be given the problem of designing joints so as to be load-carrying in one direction while stress-relieving in another.

Unusual Construction

Most of the discussion on structures up to this point has been based on vehicles which must pass through the atmosphere; the consideration of vehicles which are intended solely for outer space travel may lead to radically different and novel structural concepts. Since no precedent exists in the field, ideas on the structural configuration are not firmly defined. However, the imagination of those long interested in space has been fertile, and has produced many schemes for spacecraft, most of which have appeared in various periodicals from time to time. Not much can be said concerning purely structural problems, but conjecture can be made.

The vehicles will operate under conditions of essentially zero gravity; this condition, together

...NEWS IS HAPPENING AT NORTHROP



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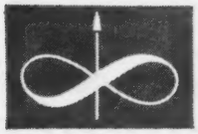

with the expense of moving weight into space, will result in extremely "flimsy" structures by our earth-bound standards. The efficient design of such lightly loaded structures and the problem of introducing concentrated loads into the flimsy shells or membrane structures will require much attention.

Serious proposals have been made to ferry such structures into space in collapsed form and then to inflate or expand them. Methods of reinforcing them must be developed. Already attention is being given the use of inflated tubes as stiffeners or of using a rigidizing foam as a means of reinforcement.

Until now, aluminum and steel have been the primary materials used in aircraft structures and powerplants, and structural joints have been formed largely through the use of rivets. For present and future hypersonic aircraft and spacecraft construction, however, the materials problem is aggravated by high temperature and consideration is being given to nearly all metals and their alloys, to their oxides, and to a host of diverse materials, including refractory materials, ceramics, plastics, and adhesives.

Two striking trends are prevalent in the development of materials for structural application: a rapid increase in the types of materials being considered, and a marked increase in the number of physical properties of concern.

While most materials exhibit desirable properties of one kind, they fail in another. Ceramics, for example, while possessing very good heat resistance and insulation properties, are heavy and brittle and possess very poor tensile and shock-resistant properties. As another example, most of the present ablating materials work well only for very high heating rates, whereby nearly all the heat is consumed immediately at the surface by the ablating process with very little heat being carried through the material by conduction.

For lower heat rates, however, conduction becomes a problem—temperature and thermal stresses occur within the ablation covering with the result that the material cracks or falls away in chunks. There are indications that some of the more recent ablation materials may not suffer these faults, but, in spite of these hopeful signs, much additional development work is needed, especially to determine when and where this relatively new concept of ablation can best be applied.

As space is penetrated, one of the new problems that must be faced is that of radiation effects from nuclear powerplants on structural materials. The problem area is relatively new and not much experience exists. The few tests made in recent years indicate that for many materials no reduction in strength is brought about by radiation; indeed, yield stress and ultimate stress are found to increase substantially in these cases, while ductility seems to decrease.

In other cases, radiation definitely causes a reduction in strength. Also, since a portion of radiation exposure ultimately appears as heat, there may be instances where strong radiation exposure can develop sufficient heat to raise the temperature of the material to a level where conventional metallurgical effects can occur. Another aspect of concern is the fact that prolonged exposure may make the materials dangerously radioactive.

Research is required in the following fields:

- Extend data on present materials into regions applicable to advanced designs.
- Develop new improved high-temperature materials through basic research in alloy systems of refractory metals, in the physical chemistry of ceramics, and in adhesives, structural plastics, glazing materials, and composite materials.
- Conduct fundamental research on the physics of solid materials, with the aim of finding and understanding the basic laws that govern deformation and fracture.
- Increase fundamental research in the chemistry of materials, organic chemistry, reactivity, chemical thermodynamics, and mechanisms of oxidation.—END

Reprinted with permission from The Aeroplane, *respected British journal of aviation, the above article is indicative of the increasing international interest in the many problems of spaceflight, especially in the councils of North Atlantic Treaty scientists whose job it is to keep track of free world advances in research and development.* The Aeroplane, *increasingly covering aspects of astronautics, is published by Temple Press, Limited, with offices in London. Subscription inquiries should be addressed to* The Aeroplane, *Temple Press Limited, Head Office, Bowling Green Lane, London, E.C. 1., England.*

Soviet Spacepower

A space vehicle could be tragically mistaken for an incoming ICBM, as was dramatically pointed out in a recent report by the House space committee, and opinion is increasing that there should be strong attention given to developing "international space law." Here are some of the Soviet views:

In substance, the Russians divide space into two regions, atmospheric space and extra-atmospheric space.

Atmospheric space is the region next to the earth that will support the flight of any kind of airborne device. This region the Russians insist should be controlled by individual states, which already have sovereignty over their own closer-in airspace.

Extra-atmospheric or outer space, the Russians declare, should not be subject to legislation, administration, or jurisdiction by any one state. In effect, outer space should be internationalized. They maintain that artificial earth satellites, for example, should bear distinctive markings, like flags on ships, so anyone could tell which state was responsible in the event a satellite fell to earth and caused damage.

The Kremlin has stated:

"It should also be recognized that apparatuses and missiles employed in cosmic flights belong to the state which launched them and that in the event of the fall of such apparatuses and missiles to earth outside the territory of the state which launched them, they, or their fragments, should be returned to the state to which they belong."

The Russians also would like an international agreement on radio frequencies to be used in communicating with satellites so as to avoid possible interference.

Finally, the Soviets call for creation of an international agency under the United Nations to study outer space. It would set up an international program to study space and perhaps continue the International Geophysical Year indefinitely.

In addition to the solar battery used to power the radio in Sputnik III, the Russians also had two experimental solar batteries aboard this satellite. Both have worked well, according to Soviet accounts, transmitting information on temperature ranges encountered and meteorite erosion. Erosion of the surface of the solar battery plate by meteorites was found to reduce the solar plate's capacity quite gradually.

The Mayak radio transmitter aboard Sputnik III continues to transmit, indicating that its solar battery plate continues to generate power.

The Russians report that Sputnik III's measurement of the magnetic fields around the earth indicates there is a gigantic system of such fields. Sputnik III recorded rapid changes in the field, indicating a possible flow pattern akin to the jet streams of air found in the upper atmosphere.

At its perigee, about 140 miles, Sputnik III encountered an atmospheric density of three ten-millionths of a gram per cubic meter. This was five to ten times greater than had been previously supposed for that altitude.

Analysis of the deceleration of Sputniks I and II shows the atmosphere is more dense in the northern latitudes than in the southern and that the atmosphere increases in depth during daylight.

Since they began going to international science meetings a few years ago, the Soviets have steadily increased their attendance at such conferences in what clearly is a government-fostered program to get the latest data from their scientific colleagues elsewhere in the world.

They even have begun to elect foreign members to their exclusive Academy of Sciences. In 1958 thirty-two foreigners were awarded such honorific titles. Russia plans, according to high-level statements, to make Moscow a recognized world scientific center.

In 1957 some 514 delegations of the Soviet Academy of Sciences visited forty-four countries and 139 other delegations attended some sixty-two international congresses. "Scientific conferences," declared *Pravda* in a recent editorial, "contribute to the establishment of personal contacts among scientists, the coordination of research, and exchange of scientific information." The Russians obviously are finding them very profitable.—END

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The myth and the missile

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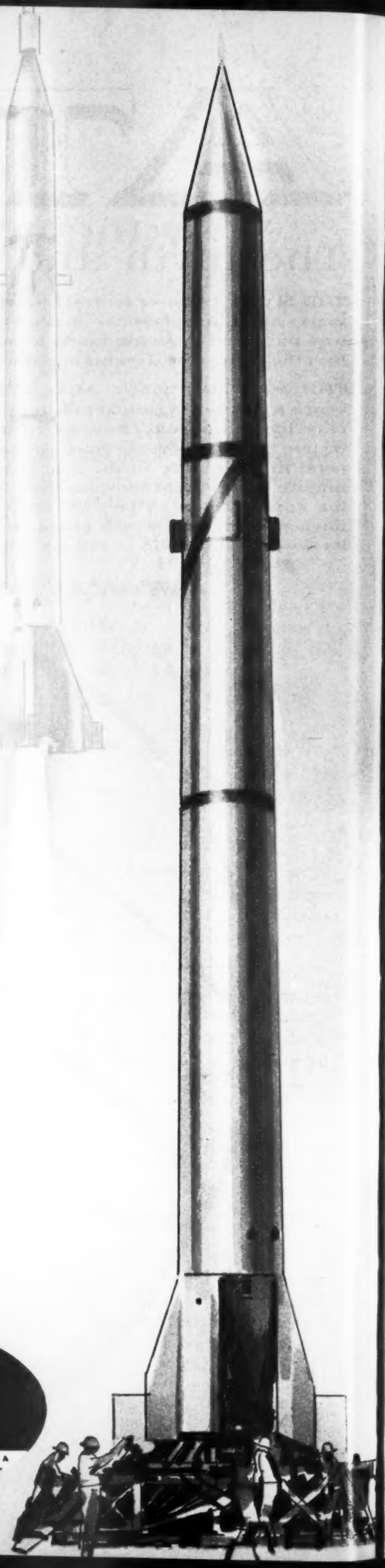

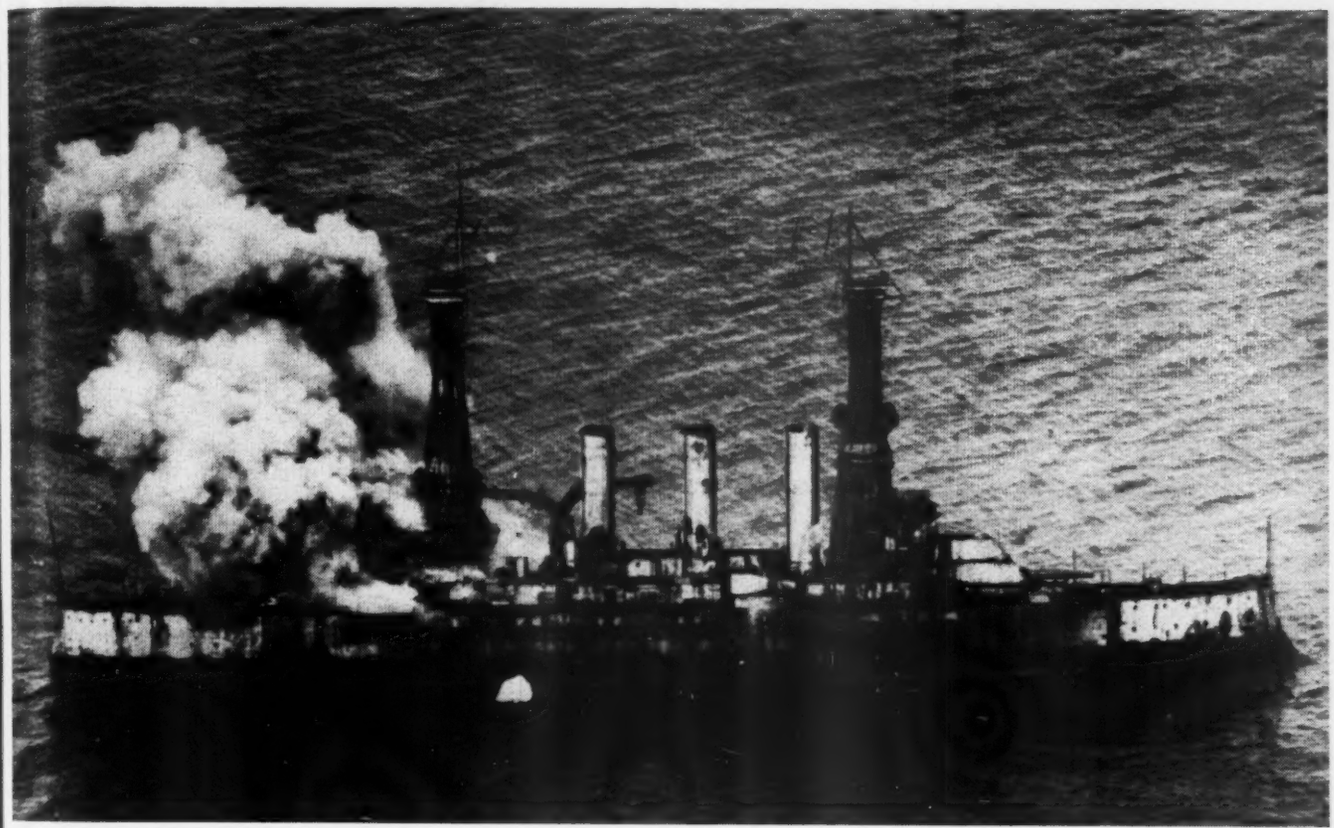

The obsolete battleship *New Jersey* billowing heavy smoke after bomb hit that sent it to the bottom of the Atlantic.

Off Cape Hatteras back in 1923 . . .

Bombers Against Battleships

Samuel Taylor Moore

MEMORIES of a day at sea off Cape Hatteras in late 1923 come back to me now and again as I read of the dizzying evolution of modern weaponry.

Events that day accurately and ominously forecast the military history to be lived during the following quarter century. Now that quarter century itself is past—but perhaps we can still learn a lesson in principle from that September day in the near long ago.

I saw two US battleships go down that day. The *Virginia* and *New Jersey* were already obsolete at the time. Yet the era's top military leadership, both Army and Navy, still maintained, at least in public, that aerial bombing could do them and their class of vessel little harm.

Billy Mitchell, a brigadier general and assistant chief of the Air Service, personally led Army Air Corps bombers to a test attack on the two ships that day. Ironically, as the two old battlewagons sank beneath the waves, Mitchell himself had passed a point of no return in his personal fortunes. Two years later his bitter opposition triumphed and Mitchell was court-martialed.

I watched the sinkings from the observer ship, the Army transport *St. Mihiel.* The action out front was by the Air Service. The Navy handled the running commentary.

Before embarking on the *St. Mihiel,* we were told that the test was to be entirely an Army Air Service show. But, oddly, the decks were awash with personable young officers of the sur-

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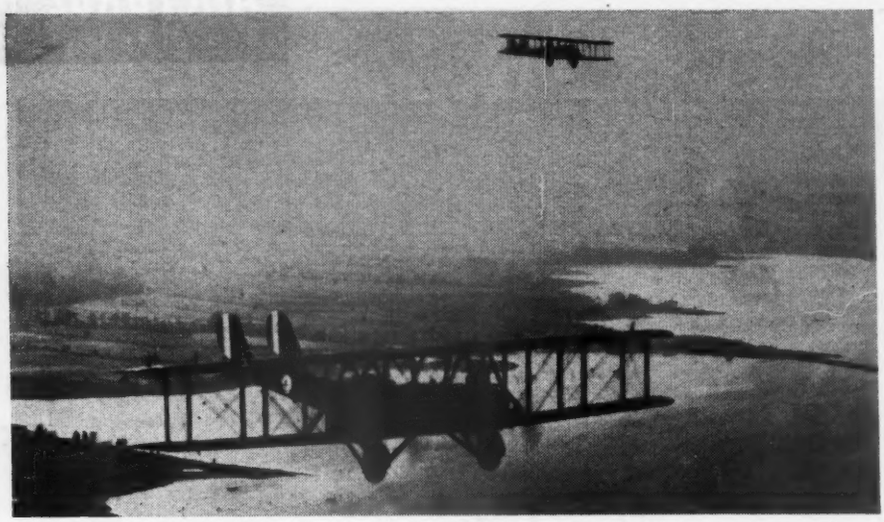


Units of Billy Mitchell's battleship-bombing Langley Field attack squadron.

face Navy greeting correspondents and congressmen as we sailed down the Potomac. We found ourselves organized in groups under their tutelage. The relatively few Air Service officers on board remained silent for the most part.

The ranking naval person on board was Rear Adm. W. R. Shoemaker, Chief of the Bureau of Navigation, who was known for his low regard for aviators. He believed 750 pilots would take care of all naval aviation needs and that flying pay ought to be cut to ten percent of base pay. Admiral Shoemaker had come aboard with something up his gold-encrusted sleeve. Gen. John J. Pershing, also no great admirer of his Air Service, was the senior Army representative aboard. The two top rankers were quite cordial to each other during the short voyage.

Word had been passed that Maj. Gen. Mason M. Patrick, then Chief of the Air Service, and generally a supporter of Mitchell's views, would brief correspondents before the tests in the wardroom of the *St. Mihiel*. We waited expectantly as General Patrick produced notes from a briefcase, not noticing the quiet entrance of General Pershing behind him.

General Patrick began with the statement that differences existed between the Army and Navy on the vulnerability of armed ships to bombs. What the rest of his briefing would have been, no one ever will know. Before he could continue, General Pershing interrupted with:

"What General Patrick is telling you is that his Air Service is having some target practice."

Somewhat surprised, General Patrick looked up, then got to his feet and saluted.

"Yes," he said, "the Air Service is having target practice." He stuffed his papers back into his briefcase, and the session ended with whispers among the audience.

The *Virginia* and *New Jersey*, 16,000-ton sister ships launched in 1905, were obsolescent by 1917. Their entire war service had been limited to training engine crews. Their Krupp armor varied from three-inch deck plates to eleven-inch reinforcement amidships, each hull divided into two compartments. Their towering twin cage-masts and triple smokestacks looked ancient even in 1923, but our Navy mentors assured us the dreadnoughts remained unsinkable by aerial bombs.

Eight planes, each carrying two 600-pound bombs, launched the first attack against the *New Jersey*. The first four bombs missed widely, but the fifth detonated near enough for its geyser to wash the decks, causing no apparent damage. Then came a direct hit. A dense black cloud with a heart of red flame arose forward. Everyone watched anxiously as the pall lifted. Topside everything appeared unchanged aboard the *New Jersey*. Rooters on both sides were tense as three less spectacular hits were noted among more bad misses. As the eight-plane aerial formation disappeared to the east, the score stood at four hits among the sixteen bombs dropped.

"Her paint hasn't been scratched," our Navy press officer said when the smoke lifted. An air officer ventured that the *New Jersey* appeared to be settling slightly at the stern. The Navy man added that ship antiaircraft would have blasted the formation from the sky before a single bomb could have been dropped. He also insisted that in a real situation the ships could have maneuvered to avoid all of the four bombs that hit.

Afer a short interval a second formation appeared. Eight more dual-winged Martin planes, each carrying a one-ton bomb and flying at 6,000 feet, appeared overhead. That represented about their limit in altitude with maximum load. Six of the next eight big bombs missed the *New Jersey* widely. But two burst close alongside. Partisans stared intently through their binoculars.

"That list is increasing. She's had it," judged one air optimist. "From here the entire deck is slanting toward me. I can even see the tops of the cage-masts."

"Bunk," snapped the Navy man. "In ten minutes her list hasn't increased one degree. Those close ones may have loosened a plate or two, but she's still sound from bow to stern otherwise."

Meanwhile, the first formation had rearmed at an advance base on Pimlico Sound. The morning was almost gone before they returned with 1,100-pound bombs, flying at only 3,000 feet.

The *Virginia* was now the target. The bombardiers were doing better. A sighting bomb fell close and the next was a near miss. The target rolled violently as the waterspout rose and fell. The third was a direct hit amidships. An ominous black cloud obscured all details of hull and deck. From the cloud fringes metal debris shot into the sea.

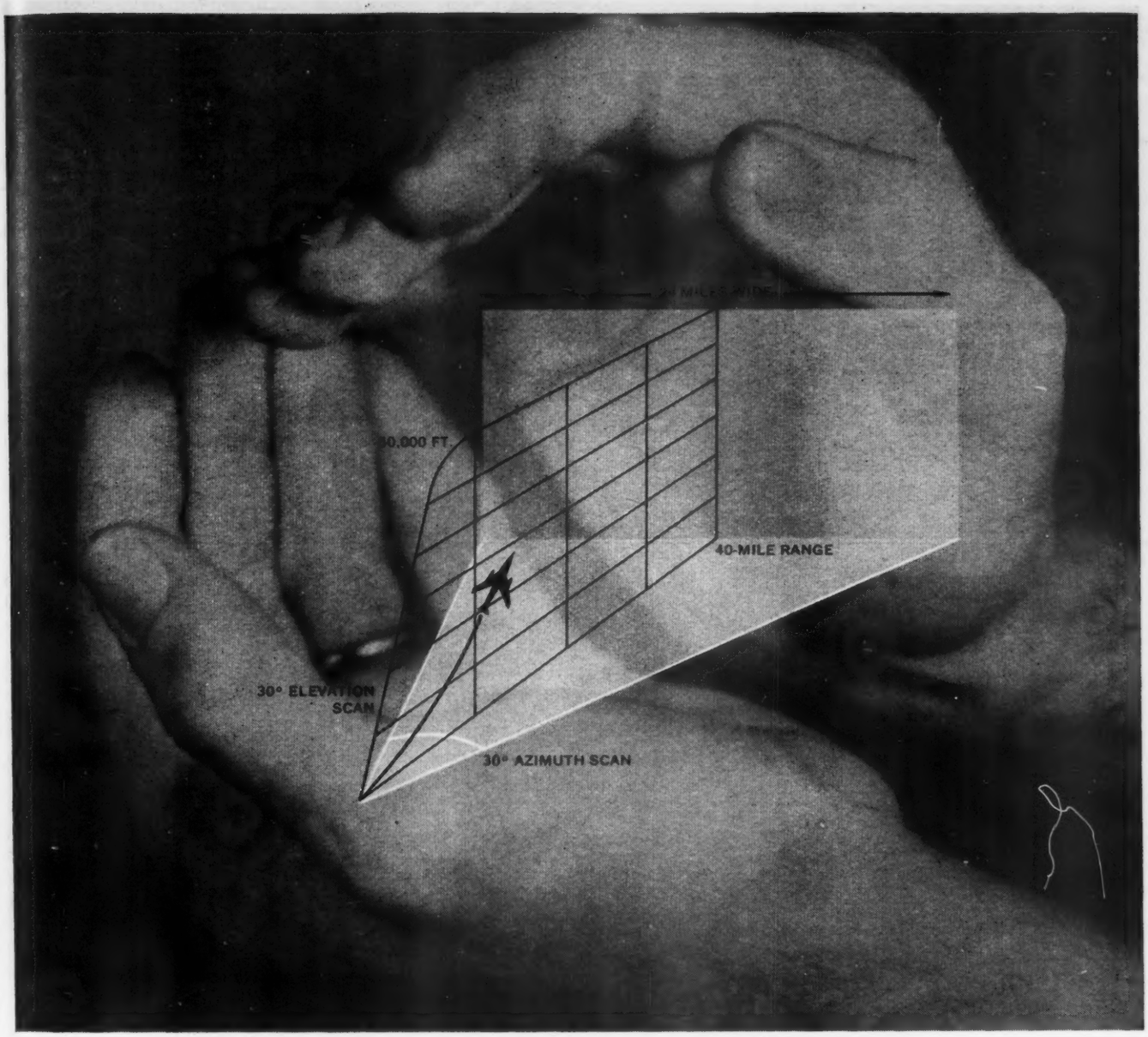
Then slowly the dark curtain lifted to reveal a dramatic picture. Cage-masts and funnels alike lay almost level along the deck like reeds before a gale.

The next two bombs were near misses. The *Virginia's* list increased abruptly.

"You civilians don't know the punishment a battlewagon can take," said our Navy mentor, with the patience of a teacher dealing with a backward class. "After Jutland, Admiral Beatty's flagship came in drawing forty feet of water and the bow was ten feet under water. The *Virginia* right now can get back to port under her own power. Remember, her forward and aft guns still can fire. She is listing, but that's because her deck wreckage is piled on one side. With a crew aboard, she'd be cleared by now."

Our informant continued in that vein as the *St. Mihiel* steamed toward the distressed ship. Nearly alongside, the transport had to veer away sharply. The crippled ship was about to sink.

(Continued on page 113)



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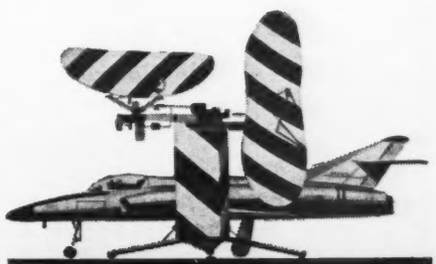

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FIREBEE ... THE HIT OF PROJECT WILLIAM TELL

"I'LL NEVER WANT TO FIRE AT TOWED TARGETS AGAIN!" That's the typical reaction of Air Force interceptor pilots after they fired at Ryan Firebee jet targets during the recent "Project William Tell" Weapons Meet. 78 Firebees, launched off the Florida coast, brought combat realism to the 10-day meet. Acting as "enemy" jet bombers, the free-flying Firebees streaked in at over 500 mph, from 14,000 to 42,000 feet, and flew an average of 31 minutes each. Air Force pilots, crews, and weapons systems met this realistic test with the most impressive teamwork and skill ever displayed at a weapons meet.

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Moments later she overturned in one great lunge. There was only a brief glimpse of her keel ranged skyward. Then slowly she slid stern first beneath the waves. Thirty minutes had passed since the first bomb fell. Soon a mass of bubbles rose to mark her resting place. The *Virginia* dead, the morning ended with a smoke-screen demonstration by an Air Service plane. Still afloat was the *New Jersey*, silhouetted defiantly in a nearly upright position.

Elsewhere on the *St. Mihiel* messages between Admiral Shoemaker and Washington went back and forth. A plan to rob the Air Service of the headlines announcing its triumph was moving forward.

At that moment, in a giant hangar at Lakehurst, N. J., reposed a recently completed rigid airship which had been built from modified blueprints of a Zeppelin captured intact in France at the close of World War I. The new airship, to be christened *Shenandoah*, was the first rigid ever built in America. For several days before weather had favored its trial flights, but it had not been moved out of its hangar. As the *Virginia* went down, the barometer at Lakehurst was beginning to fall. Conditions were not ideal for a maiden flight of an unproved aircraft, but certainly a successful demonstration would capture newspaper headlines the next day. And naval publicity minds correctly reasoned that a *Shenandoah* flight would grab those headlines in a big way.

But headlines or not, the tests proceeded.

The weather was closing in more rapidly as the second aerial formation appeared on the horizon to resume attack on the *New Jersey* from about 3,000 feet, again armed with 1,100-pounders. Only three bombs looked at all effective out of eight dropped. The best was a detonation close alongside that sent a familiar water tower over the deck.

A few minutes later five more planes flew across the darkening horizon. The leading plane was Billy Mitchell's. Four Martins followed at 4,000 to 5,000 feet, again loaded with one-ton bombs. Obviously the quartet represented a last chance. If it failed, the Navy would call for gunfire to sink the *New Jersey* before dark.

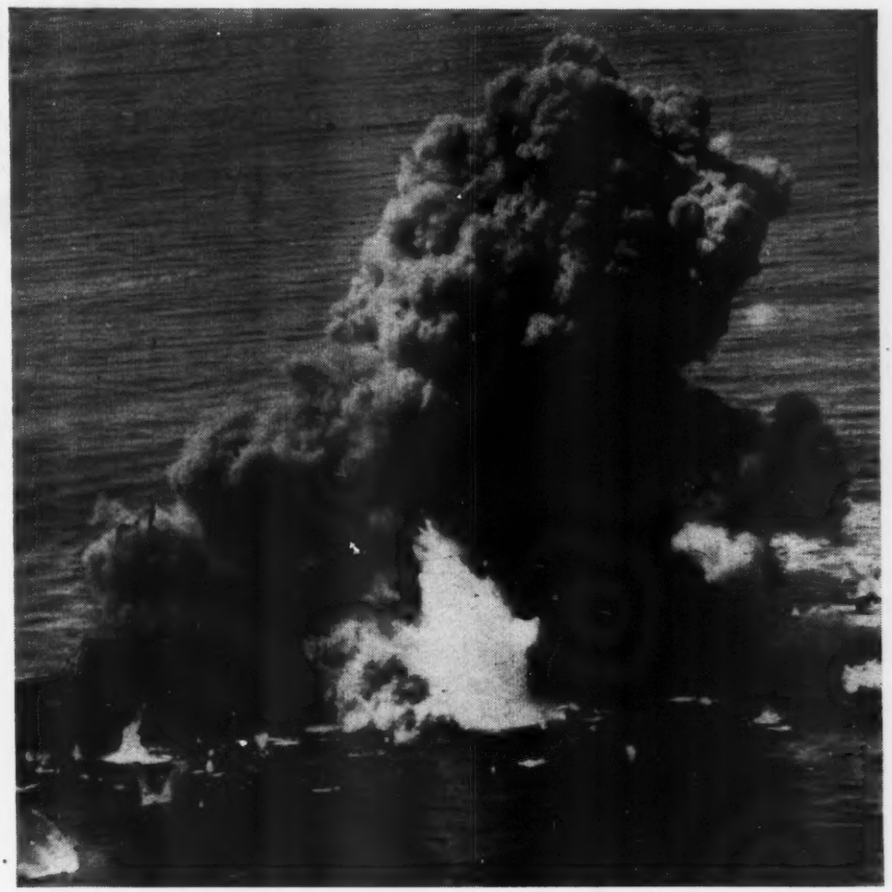
The first bomb fell close alongside, its geyser pouring water across the slanted deck. The next was another near miss. What seemed a long interval passed as the next plane twice crossed the target. The bombardier was making sure. Then his bomb detonated within the hull, shooting up a telltale flash of red and black doom. The *New Jersey* heaved in agony.

"That *was* a lucky shot," exclaimed a voice nearby.

"The bomb must have gone right through the grating over the boiler room."

The dying ship was now listing fast. Soon it gracefully executed half a barrel roll, showing us a red, encrusted bottom as had the *Virginia*. She started down, stern first, with a sliding motion, and soon was out of sight.

The *St. Mihiel* stood alongside. Six minutes had elapsed since the burst within the hull.

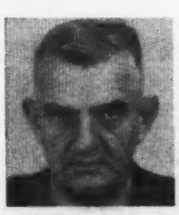


Behind the ominous black cloud floats the *Virginia*, a dying dreadnought with a mortal wound. The ship took its final symbolic plunge a few minutes later.

On the sail back home the Navy press man conducted a review of all we had been taught. He was a likable and polite person, and I felt concern for him. He obviously sincerely believed that what had happened couldn't have happened.

Meanwhile, ironically, the *Shenandoah* publicity coup succeeded only in degree. Before presses began to roll the next morning, news of the great Japanese earthquake flooded city rooms. But the *Shenandoah* flight still topped what seemed to be the less dramatic story of battleships sunk by bombs.

That was thirty-five years ago. And now we are on the threshold of the space age.—END



The author, Samuel Taylor Moore, has served in three wars, retiring as an AF colonel in 1953. He covered the Mexican punitive expedition in 1916 as a newsman, then became a balloon pilot and commander of the 7th Balloon Company in France in World War I. He also served in the CBI and, more recently, in Korea. Now a free-lance writer, he has done several articles for this magazine in the past.

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The READY ROOM

RESERVE AND AIR GUARD NEWS

An **AFA-backed** Defense Department **proposal to amend the Reserve Officer Personnel Act of 1954** has gone into the Washington pipeline with the **blessing of Defense Secretary Neil McElroy.** Major provisions of the proposal, supported by the AFA Air Reserve Council:

- Under a **"term retention contract"** Reserve officers would receive **readjustment pay** on release from active duty equal to the **product of two months' base pay** multiplied by the number of years served under contract. Maximum money received would not exceed two years' pay.
- Length of contract would be determined by the armed service on the basis of its requirements. **Maximum length of contract** would be set, however, at **six years.** No contract would be used for the initial two-year period of obligated service.
- After **fourteen years' service** a Reserve officer would either be tendered a **Regular commission,** receive a new six-year contract to bring him to the twenty-year retirement point, or **be separated with readjustment pay.**
- A Reserve officer **involuntarily separated before normal expiration of his contract** would receive an additional payment, over and above regular readjustment money. This payment would be equal to one month's pay times the number of unserved years in the contract.

• • •

Air Guardsmen in RF-84s and RB-57s have been flying tri-purpose missions in recent weeks. The flights are part of a so-called **"Eye-opener" test penetration series** requested by the **Air Defense Command.** Along with helping ADC keep sharpened up, the Guard pilots also gain simulated combat condition training. And, in addition, the test flights are utilized for **photo reconnaissance purposes.**

Late this spring the **Guard and the Air Reserve join the Army** in **"Exercise Pine Cone II"** near Fort Bragg, N. C. The Guard will take part as a **tactical air force,** the Reserve as a **troop carrier force.** Aircraft involved will be **150 Continental Air Command C-119s** along with eighteen **F-84Fs,** eighteen **RF-84Fs,** and eight **SA-16s** supplied by the Guard.

• • •

Hang onto those ID cards. Faced with opposition from AFA's Board of Directors and other groups, the Defense Department has revoked its decision to invalidate current Reservists' identification cards and issue new ones. The present card remains in effect.

• • •

As forecast by senior editor Claude Witze in the December issue of this magazine, **Congressman Overton Brooks** (D.-La.) has given up his Reserve Subcommittee to become chairman of the **House Space Committee. Congressman L. Mendel Rivers** replaces Mr. Brooks at the head of the Reserve Subcommittee.

South Carolinian Rivers, a veteran member of the House Armed Services Committee, is expected to act as **outspoken champion of the Reserve Forces in his new position.** He has long been a firm supporter of a militarily strong national posture.

• • •

Air Force Reserve personnel on active duty face little change of RIFs as a result of a new Defense Department manpower reduction ruling. The USAF came into the new year with a personnel total of **863,800,** slated to drop to 850,000 in short order on the basis of early releases and decreased new procurement.

• • •

The AFA-sponsored **World Congress of Flight** set for Las Vegas from **April 12 to 19** will boast a concentration of **Reserve Forces leaders.** Scheduled to meet in the Western city during the World Congress of Flight are the **Air Force Reserve Policy Committee, the Air Reserve and Air National Guard councils of the Air Force Association, as well as the Air Affairs Committee of the Reserve Officers' Association.**

Defense and Bureau of the Budget **economy chiefs are questioning** the **thirty-six extra paid training periods** for **Reserve and Air National Guard flyers.** The AF stoutly maintains that the additional periods are absolutely essential. **It will fight to keep them.**

• • •

The Air Force **Reserve Records Center** assumed **new responsibilities** as of January 1. This office now has charge of **transferring qualified Air Force Reservists to the Retired Reserve Section** for placement on the **next USAF Reserve Retired list** without pay. ARRC took custody at the same time of retired Reserve records for persons retired without pay.

In another responsibility switch, the **Directorate of Operations of the Continental Air Command takes over individual and unit training of Air Reservists on March 1.** These functions were previously split among the offices of Reserve Personnel and Operations at both CONAC and the numbered air forces. The move clarifies the interrelationship between the two phases of training and centralizes their administration.

• • •

Air Force **Reserve majors and captains** not on extended active duty with **promotion dates of June 30, 1953 or earlier** will be considered by promotion selection boards in the near future. The majors' records go before the board **March 2-6.** The captains come up **February 24-27.** The boards meet at the Air Reserve Records Center, Denver, Colo.

(Continued on following page)

World War II DFCs, Air Medals for Reservists Lt. Col. Clifford Molzahn, Maj. William Koring, Capt. Francis Kastory, among 211 "back medals" to 9524th Air Reserves in Cleveland ceremony. The gal? Area Miss Air Reserve Martha Elmore.

Reserve officers eligible for consideration for promotion are authorized by section 8362, Title 10, United States Code, to **submit letters to the president of the selection board** containing information they wish the board to consider on their behalf. Letters should be received at the above address ten days or so before convening dates.

The boards will consider **approximately 1,100 non-active-duty majors** for promotion to Reserve **lieutenant colonel** and **some 3,000 captains for selection as majors.** Reserve officers assigned to the Inactive Status List Reserve section are not eligible for promotion.

• • •

The annual **two-week military medical training program for Reserve officers** begins at the **National Naval Medical School,** Bethesda, Md., on **March 9.** The program is offered jointly by the armed forces once a year. It features **instruction in the medical aspects of special weapons and radioisotopes.** Attendance is limited to Reserve officers and warrant officers of the medical services not on extended active duty.

Only **prerequisite** for attendance is that the officer must be **participating for training in Category A through D units.** Applications should be made through local unit of assignment and reach CONAC by early in February each year.

• • •

The following CONAC facilities go **over to civilian operation by the end of fiscal year 1960** under a recent Air Force ruling: **Long Beach MAP, Calif.; Bakalar AFB, Ind.; Dallas NAS, Tex.; Grenier AFB, N.H.; Greater Pittsburgh Airport, Pa.;** and **Memphis AFB, Tenn.** Military air base units will be phased down and discontinued at these installations by the end of FY 1960. They will be operated in support of Reserve training, utilizing Air Reserve technician elements of Reserve troop carrier units and Civil Service employees where necessary. The Air Force has authorized discontinuance of area support responsibilities, with limited exceptions, in keeping with restriction of primary missions to Reserve training in these cases.

• • •

Six Air National Guard squadrons went off alert status and **eight others** went on at the start of the new year. This left a total of **twenty-two squadrons** on alert status. Off came the 132d, **Bangor, Me.;** 156th, **Charlotte, N.C.;** 127th, **Wichita, Kan.;** 128th, **Dobbins, Ga.;** 125th, **Tulsa, Okla.;** 175th, **Sioux Falls, S.D.** On went the 196th, **Ontario, Calif.;** 120th, **Denver, Colo.;** 187th, **Cheyenne, Wyo.;** 109th, **Minneapolis, Minn.;** 157th, **Eastover, S.C.;** 146th and 147th (interchangeably), **Pittsburgh, Pa.;** 133d, **Grenier, N.H.;** 152d, **Tucson, Ariz.**

• • •

The **459th Troop Carrier Wing,** Andrews AFB, Md., has become the **first Air Reserve organization in the continental US to assume full status under the Air Reserve Technician Plan (ART).** The wing, under **Brig. Gen. Ramsey D. Potts,** was judged to have attained a level of capability where it could assume activities and duties similar to those of a regular Air Force wing.

Col. Campbell Y. Jackson is wing deputy and ART commander. He is responsible for **aircraft deployment, training, materiel control, wing facilities, and personnel.**

—By the Staff

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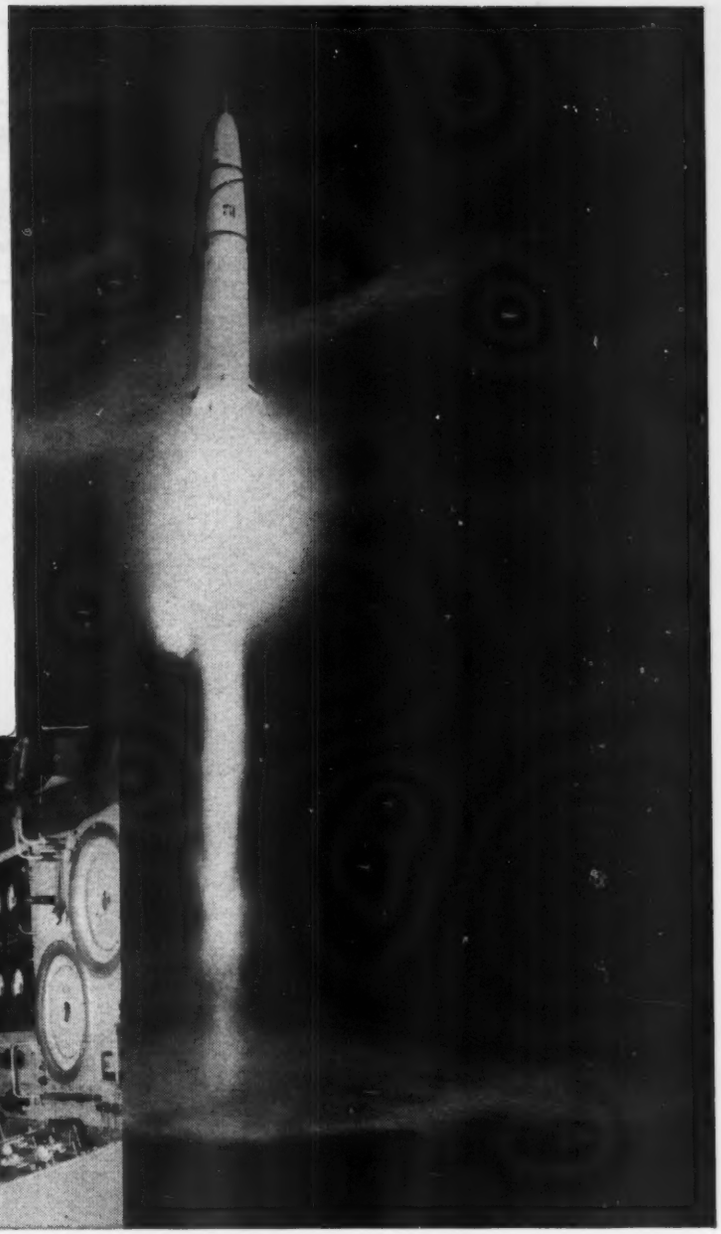
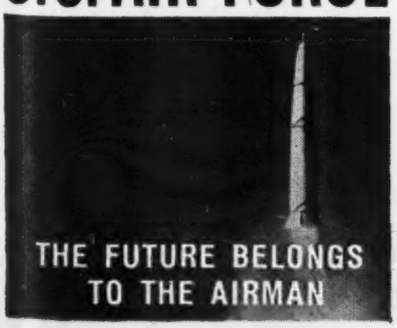


AS A SPECIALIST IN THE U.S. AIR FORCE



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airman's bookshelf

British coauthors William Green and John Fricker have supplied an extremely valuable addition to aviation reference libraries in *Air Forces of the World* (Hanover House, $10.95). The book is an obvious companion volume to the time-honored standby, *Jane's All the World's Aircraft*. The new work, in contrast to *Jane's*, focuses its full attention on fighting planes.

Green and Fricker deal with history, development, and current strength of the air forces of eighty-three nations. *Air Forces of the World* provides a ready source of information on equipment, bases, organization, operations, manpower, leaders, and a vast assortment of associated facts. More than 500 photographs are included.

Narrative surveys treat the growth of each air force from its beginning, actions in which each participated, numbers and types of aircraft involved at each stage of the game, and so forth. In addition, maps show military air bases and civil fields that could be converted to military use.

The book painstakingly runs the geographical and alphabetical gamut from Afghanistan to Yemen and Yugoslavia, a lot of ground even in the jet-missile age.

• • •

Another major reference work for airman and the air-minded is the second edition of *Who's Who in Aeronautics and Astronautics* (American Aviation Publications, $12.50). Listed are 3,100 leading figures in the services, industry, commercial aviation, science, and literature. This is an up-to-date fact-finder on persons who have done much to shape the age in which we live.

• • •

Latest contribution to the ever-growing field of aviation history is *The Air* (Philosophical Library, $12), by another Briton, Dr. Edgar B. Schieldrop. The author sketches the story of mechanical flight with a broad brush, perhaps too broad for some. Photos and text present the familiar saga from man's earliest attempts to get off the ground right up through jet aviation. Schieldrop devotes separate sections to aerodynamics, the principles of flight, early flying machines, balloons, all the usual steps along the path into space. Then, coming up to date, he deals with high-speed, high-altitude jets, space test vehicles, and rockets and missiles.

But, unfortunately, a lot is also left out. Schieldrop, basing much of his work on British aviation, ignores many major American accomplishments of recent years—including the development of vertical takeoff aircraft, the non-stop Boeing B-52 flight around the world, and the altitude and speed achievements of the Lockheed F-104 Starfighter and the Bell X-2 test vehicle. Minor technical inaccuracies also crop out here and there.

The Air is one of a four-volume series entitled *The Conquest of Space and Time*.

• • •

Here's one for the fighter boys—and many of the rest of us as well. It's a collection of ten tales of wild, swirling aerial combat from the pen of World War I ace and long-time aviation fiction writer Arch Whitehouse. *Fighters in the Sky* (Duell, Sloan & Pearce, $3.00) spins realistic yarns about fighter pilots in combat in the first and second World Wars and over Korea.

Whitehouse himself, who was credited with sixteen "kills" as a member of 1914's Royal Flying Corps, believes the fighter pilot has just about moved into history with the advent of missiles. The merits or demerits of this view don't affect the spirit of high adventure in this book.

• • •

Several new volumes join the literature of rocket and missile science:

Rockets and Satellites (Vol. VI in the Annals of the International Geophysical Year) edited by L. V. Berkner (Pergamon, $25) is a collection of papers from existing literature covering all aspects of the IGY rocket and satellite program—theory, research, development, construction, test, and results. Many papers appear in original form, while others have been revised. They are highly illustrated. The book is designed as a guide for the technician and specialist working in theoretical or experimental programs.

• • •

In *Guided Missile Engineering*, edited by Allen E. Puckett and Simon Ramo (McGraw-Hill, $10), seventeen engineering scientists go into the fundamentals of electronics, guidance theory, aerodynamics, airframe performance and a dozen other guided-missile engineering subjects. The essays combine theory and practicality and emphasize the systems engineering aspect. A valuable book for the engineer, technician, student.

(Continued on page 123)

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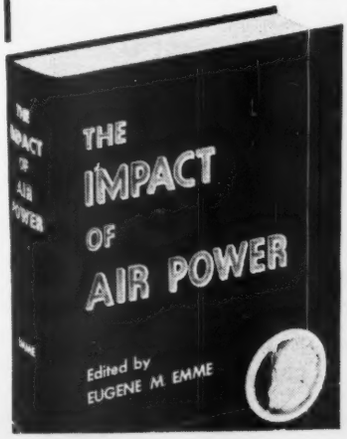

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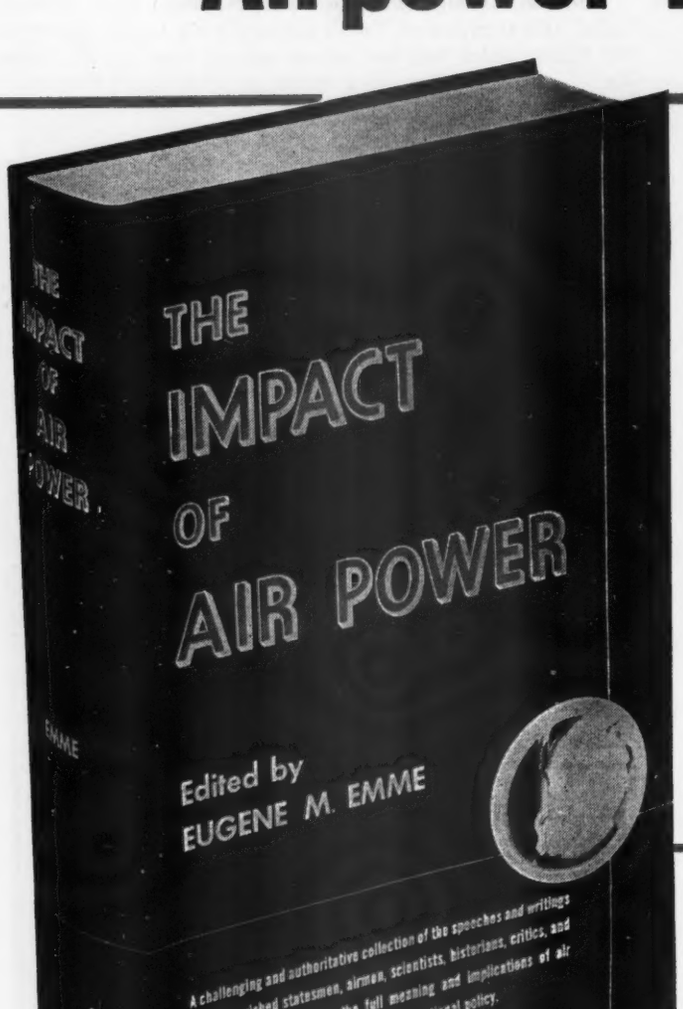
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The Editor

Dr. Eugene Emme, former Professor of International Politics at the Air University and Director of the Graduate Study Group of the Air War College, has also served as Research Adviser on the faculty of the Air War College. He is currently engaged in Operations Research with the Office of Defense and Civilian Mobilization.

A pilot himself, with service in World War II, Dr. Emme has spent nine years compiling, analyzing, and selecting the best and most important statements, the speeches and writings of every major historical figure who has influenced air and spacepower.

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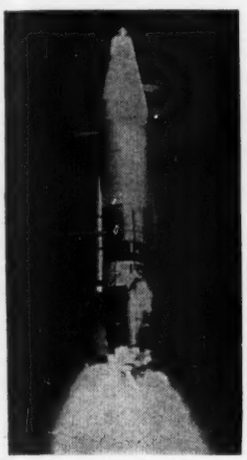

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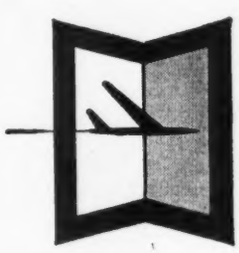

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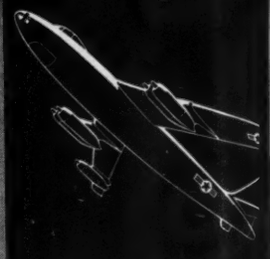

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Andrew G. Haley, President of the International Aeronautical Federation and general counsel to the American Rocket Society, is a busy man. His new book, *Rocketry and Space Explorations* (D. Van Nostrand, $6.75) unfortunately shows evidence of being fitted into a crowded schedule.

Haley traces the development of rocketry and does quite well through World War II. In the chapter on post-war rocketry in America, however, material on the Air Force ballistic missile program and the Ballistic Missile Division in particular is conspicuous by its absence. Nor is the Air Force space medicine program given its just due. In this chapter and in the selection of photographs there is evidence that the research effort was not in keeping with the scope of the book.

It is a good first try. Perhaps succeeding editions will rectify these mistakes and make this a truly first-class reference work.

• • •

Dr. Armand Spitz, Coordinator of Visual Satellite Observations for the Smithsonian Astrophysical Observatory, Cambridge, Mass., and Frank Gaynor, author of the recent *Encyclopedia of Atomic Energy*, collaborate on a useful space age reference, *Dictionary of Astronomy and Astronautics* (Philosophical Library, $6). It contains definitions of more than 2,200 key words, terms, phrases, and concepts from the sciences of astronomy and astronautics. Maps of the stars, moon, and constellations appear in a special section with select photos of the universe and tables of data on orbits of planets, solar system satellites, star magnitudes, and the like. *Nuclear Rocket Propulsion*, by R. W. Bussard and R. D. Delauer (McGraw-Hill, $10), is a highly technical discussion of structural analysis, heat transfer, fuel flow, thermodynamics, ballistic flight, reactor physics, and radiation safety. The authors are both scientists.

For Younger Readers

Guide to Rockets, Missiles and Satellites, by Homer E. Newell, Jr., (Whittlesey House, $2.50)—The Assistant Director of Space Science, NASA, writes a brief history of modern rockets and missile development, describes the working principles of all types of rockets and missiles today, and explains the technical terms most frequently used. Each rocket, missile, and satellite involved in service programs of NASA is pictured with latest releasable technical and operational information. For the teen-ager.

Exploring the Planets, by Roy Gallant (Garden City, $2.95)—A beautifully illustrated, clearly written survey of the universe and the planets, including speculation about their origins and theories on their composition. A good beginner for space-minded youngsters, ages eight to fourteen.

From Submarines to Satellites: Science in our Armed Forces, by Margaret O. Hyde (Whittlesey House-McGraw-Hill, $3)—An illustrated account of the scientific advances made by our armed forces, pointing up the need for young men and women to follow military careers and the excellent scientific training offered by the services.

Operation Vanguard, by Werner Buedeler (Roy Publishers $3.75)—Well-known European science writer presents a popular account of the erratic Vanguard project, describes American missile testing and explains satellite theory, orbiting, and visual tracking. For ages fourteen and up.

Related Reading

Fall and early winter publisher listings contain an unusual number of volumes on Soviet Russia and Communism. Some give rare intimate glimpses behind the Iron Curtain. Among those we recommend are:

What We Must Know About Communism, by Harry and Bonara Overstreet (Norton, $3.95)—A top-grade analysis and diagnosis of Communism as it affects American life in terms of theory, the Party, and the Soviet Union.

Doctor Zhivago, by Boris Pasternak (Pantheon, $5)—Nobel prize-winning novel by a Russian writer giving an unflattering picture of Communism during and after the Revolution.

Stalin's Failure in China, 1924-1927, by Conrad Brandt (Harvard Univ. Press, $4.75)—A scholarly study of the evolution of communism in China, through Mao Tse-tung.

The Secret Name, by Lin Yutang (Farrar, Straus and Cudahy, $3.95)—The development of Soviet Russia, its political history, and the basic nature of Communism.

The Russian Revolution, by Alan Morehead (Harper, $5)—A meaningful account of this world-changing internal struggle.

Soviet Policy and the Chinese Communist, 1931-1946, by Charles B. McLane (Columbia Univ. Press, $5.50)—A serious, thoughtful, well-presented study of the two vast Communist powers.

(Continued on following page)

OFFICIAL ANNOUNCEMENT

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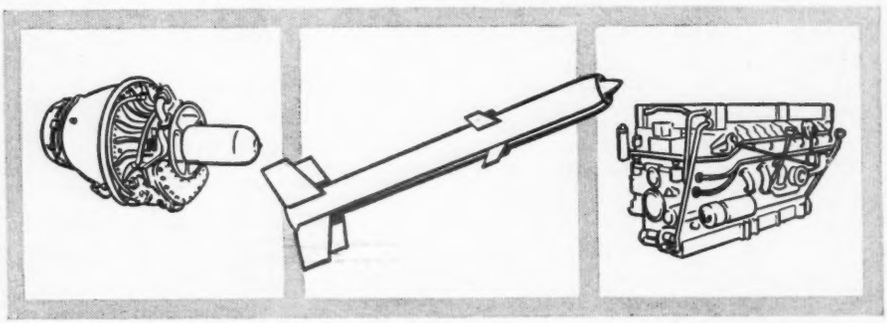

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Stalin's Correspondence With Churchill, Atlee, Roosevelt and Truman, 1941-1945 (Dutton, $7.50)—The messages and letters exchanged and first published in the USSR in 1957.

Stalingrad: The Battle That Changed the World, by Heinz Schroter (Dutton, $5)—A popular historical account of Soviet Russia's greatest victory in World War II, with emphasis on the human aspects of battle tragedy and the extermination of 200,000 crack German troops.

Smolensk Under Soviet Rule, by Merle Fainsod (Harvard Univ. Press, $8.50)—A RAND Corporation study of life in Smolensk up to 1941, describing Communist rule and its effect on Russian people and their leaders.

Eastern Exposure, by Marvin L. Kalb (Farrar, Straus and Cudahy, $4.50)—A fresh look at Communism through the experience of a former press attaché at the US Embassy in Moscow. The book deals with the year 1956 during which Khrushchev appeared to relax Soviet policy and attitude toward the West.

• • •

In Flanders Field: The 1917 Campaign (Viking, $5), is an account by Leon Wolff of the Third Battle of Ypres, in which more than 150,000 British soldiers were killed.

• • •

Many American flyers in World War II were victims of Japanese atrocities which ranged from beheading prisoners of war to brutal prison policies.

The Knights of Bushido: The Shocking History of Japanese War Atrocities, by Lord Russell of Liverpool (Dutton, $5), examines crimes committed by Japan's armed forces against both civilians and POWs between 1939 and 1945. Actual cases from the proceedings of the International Military Tribunal are vividly described. This book, a shocking flashback into the days of World War II, is one that Americans might mark well in the current struggle against military dictatorships.

• • •

Drew Pearson and Jack Anderson, veteran Washington newsmen, charge into the Administration's military affairs in *U.S.A.—Second-Class Power?* (Simon and Schuster, $3.95). They conclude that US military power is suffering a critical decline. Personal interpretation based on select documentation runs throughout the work.

—MAJ. JAMES F. SUNDERMAN

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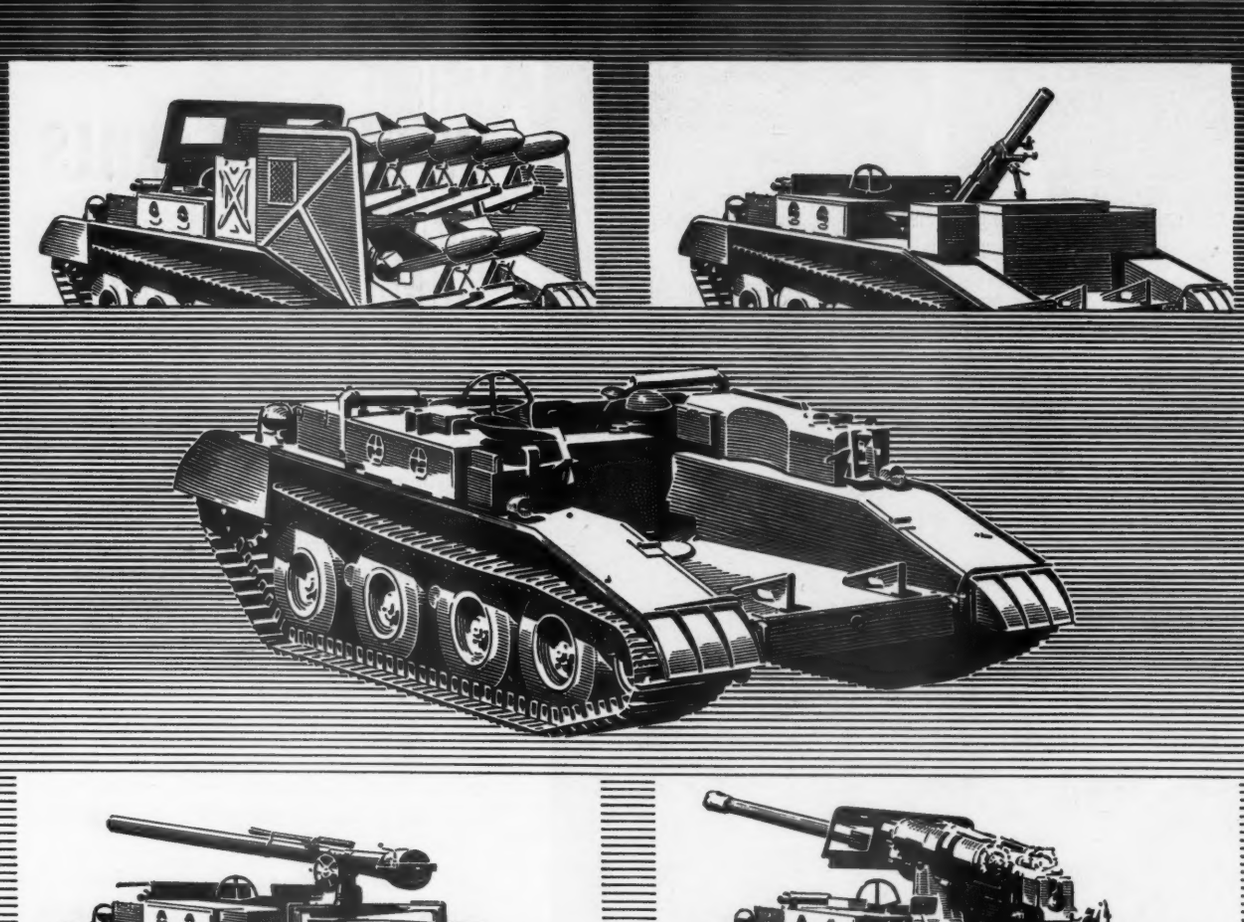

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Adaptability of thinking and facilities at the Cleveland Ordnance Plant is reflected in the wide range of projects successfully undertaken for the Armed Forces. Adaptability has been achieved, too, in devising new uses for the currently "in-production" M-56 Scorpion. Designed as a 90 MM assault weapon, the M-56 is now ready to serve with equal effectiveness as a recoilless rifle or mortar mount, rocket and missile launcher, or as a personnel or cargo carrier. What's more, the ultra-lightweight aluminum and steel-alloy construction of the M-56 makes all of these adaptations air-transportable and air-droppable, as well as extremely mobile in mud, sand or snow. The adaptability of our engineering, our facilities and the "in-production" M-56 can help solve *your* ordnance problems, today.

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AFA NEWS

SQUADRON OF THE MONTH

Billy Mitchell Squadron, Milwaukee, Wis., Cited for

Outstanding community service, through its annual awards banquet, a program that calls attention to the aviation contributions of Wisconsin, enhancing a basic aim of the Air Force Association.

Milwaukee's Billy Mitchell Squadron honored **Lockheed's chief test pilot, Herman "Fish" Salmon** with its annual **Billy Mitchell Award** at a banquet on December 11. The citation goes annually to a native of Wisconsin judged to have made **"outstanding contributions to aviation."** Former Milwaukean Salmon zoomed back for the occasion from **a round-the-world test flight of the new Lockheed Electra.**

Guest speaker was **Lt. Col. Paul Nadler** of the Defense Department's **Advanced Research Projects Agency** (ARPA). He talked on **space exploration** and conducted a lively **question-answer period** on the subject. Among the honored guests also was Wisconsin's first licensed pilot, **Jerry Kaminski. Squadron Commander Bob Gerlach** presented a plaque to award-winner Salmon (*see cuts below*).

Minnesota educators gather before dawn at the flight line to be checked in and receive equipment for their trip to Colorado Springs, where the group inspected the headquarters of NORAD, saw operations at the new Air Force Academy.

The **Minneapolis Squadron** reports it's moving ahead in a program to **educate the public to the air and space age.** Early in December the squadron, under **Commander Sherman Kleckner** and **Wing Commander Ed Kube,** piled a group of state and city educational leaders into an AF C-119 and took them to **Colorado Springs.** They toured **Ent AFB facilities** as guests of the **North American Air Defense Command,** lunched at the officer's club with **Maj. Gen. Harvey T. Alness,** and spent the afternoon at the Air Force Academy.

The educators went over the Academy with a fine-tooth comb and seemed impressed with educational opportunities afforded cadets.

Famed woman pilot **Jacqueline Cochran** was guest speaker at the **Georgia Wing's annual banquet** in Atlanta late in November. Miss Cochran stressed the value of our **overseas bases in maintaining national security.** She also related some of her own experiences.

Georgia Governor S. Ernest Vandiver introduced Miss Cochran. Vandiver is a former Wing Commander and National Director. Present **Georgia Wing Commander John T. Allan** was in charge of arrangements.

Another feature of the program was presentation of an AFA award to **Massachusetts Institute of Technology student Leland Jackson,** a native of Atlanta, who was one of the two first-prize winners at the 1958 National Science Fair in Flint, Mich.

(Continued on following page)

Herman Salmon, left, accepts the Billy Mitchell award from Milwaukee Squadron Commander Bob Gerlach. Joining in congratulations, Lt. Col. Paul Nadler, Judge Robert Landry.

Plaque-winner Salmon, better known as "Fish," proudly shows his award to Mrs. Martin Fladoes, sister of the late Billy Mitchell, always a top guest at the annual program.

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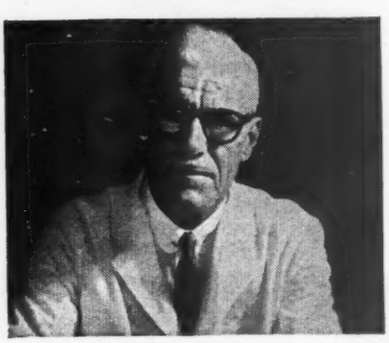

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AFA NEWS — CONTINUED

Recent fascinated visitors to the Dayton Air Force Depot were the Commander of the Dayton AFA Squadron, Morris Ribbler, left, and Ohio Wing Commander Jack Jenefsky, right. Here they are getting a demonstration of Depot's electronic marvel, the Robotester, from Col. W. W. Horton of logistics support management.

The **Dayton Squadron** gave its annual dinner honoring **Gentile Air Force Station** on December 2. The banquet is the yearly highlight of squadron programs. The logistical support management chief at the Dayton depot, Col. W. W. Horton, delivered the evening's main address, entitled **"The New Concept in Logistic Support Management."** A new **organizational chart of the base** was unveiled in this connection.

Civic leaders and industry representatives joined AFA members in the audience. **Squadron Commander Morris Ribbler** acted as master of ceremonies *(see cut).*

CROSS COUNTRY . . . Plans for the third annual **Utah Wing Airpower Symposium,** always a top attraction on the airpower calendar, are currently under way, according to **Dale Erickson,** general chairman of the 1959 program. The Symposium will be held at the **Hotel Utah in Salt Lake City, May 14-16 . . . Alan Cross,** National Director whose home is in Miami, tells us that the **Miami Squadron and Florida Wing** cooperated in the big **dedication ceremonies for the new Miami International Airport terminal** on January 31-February 2. A feature of the AFA sponsorship was the luncheon on the thirty-first which listed among the speakers **Missouri Sen. Stuart Symington** and **Florida Gov. LeRoy Collins . . . Gen. Jimmy Doolittle, a founder and the first President of AFA,** has retired after thirty years with the **Shell Oil Co.** At least he's retired from Shell, although he's accepted a new position as **Chairman of the Board of Space Technology Laboratories,** Inglewood, Calif. . . . **Kansas City's Mohawk Squadron** cooperated in the ceremonies dedicating the **new SAGE system** at nearby **Grandview AFB** on January 30. A luncheon and press inspection were included in the program . . . **AFA's Board of Directors** will hold its **next meeting on June 4 in Colorado Springs.** One feature of the meeting will be **attendance at the graduation ceremonies** for the **first AF Academy cadet class.** Invitations to this function are extremely limited, and AFA is very proud to have been so honored . . . **New York City's first chartered Squadron, the WAF Squadron,** held its **twelfth anniversary banquet,** at the Savoy-Hilton Hotel on January 24. This was the kickoff of a program designed to render financial support to the **Falcon Foundation,** a group organized in Texas to **assist outstanding prospective AF Academy cadets** to attend the Academy. **Gen. Bob Smith,** an active member of AFA and head of the Falcon Foundation, briefed the AFA Board of Directors on the Foundation during the Dallas Convention . . . **Art Storz of Omaha,** AFA's all-time number-one membership chairman, advises us that the **1959 membership campaign** is getting ready to get off the ground, with an aim of equaling the past four years. The Omaha gang has come up with about **2,000 members each year . . . Jerry Green, Wing Commander of Michigan,** announces the formation of a new **Squadron in Berkeley** headed by **Fred Bonjour,** a former officer in the Detroit Squadron and the Wing. The members chose for the name of their Squadron the **Gen. Claire Chennault Squadron,** honoring the late famed flyer. **Mrs. Chennault** has written her best wishes to the new unit.

—Gus Duda

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Functions of the DEPARTMENT OF DEFENSE

In line with the policy of Air Force *Magazine, which calls for the documentation of important airpower material, we are printing herewith the texts of two Defense Department directives. They were promulgated on New Year's Eve to make a reality out of the Defense Reorganization Act of 1958, under which the unified and specified commands became responsible on January 1, 1959, to the Secretary of Defense through the Joint Chiefs of Staff. It is expected that the Secretary of Defense will issue other directives to clarify the roles and missions of the Army, Navy, and Air Force.*

SUBJECT Functions of the Department of Defense and its Major Components

REFERENCES: (a) *DoD Directive 5100.1, "Functions of the Armed Forces and the Joint Chiefs of Staff," March 16, 1954 (canceled herein)*

(b) *DoD Directive 5158.1, "Organization of the Joint Chiefs of Staff and Relationships with the Office of the Secretary of Defense"*

I. INTRODUCTION

Congress, in the National Security Act of 1947, as amended, has described the basic policy embodied in the Act in the following terms:

"In enacting this legislation, it is the intent of Congress to provide a comprehensive program for the future security of the United States; to provide for the establishment of integrated policies and procedures for the departments, agencies, and functions of the government relating to the national security; to provide a Department of Defense, including the three military departments of the Army, the Navy (including naval aviation and the United States Marine Corps), and the Air Force under the direction, authority, and control of the Secretary of Defense; to provide that each military department shall be separately organized under its own secretary and shall function under the direction, authority, and control of the Secretary of Defense; to provide for their unified direction under civilian control of the Secretary of Defense but not to merge these departments or services; to provide for the establishment of unified or specified combatant commands, and a clear and direct line of command to such commands; to eliminate unnecessary duplication in the Department of Defense, and particularly in the field of research and engineering by vesting its over-all direction and control in the Secretary of Defense; to provide more effective, efficient, and economical administration in the Department of Defense; to provide for the unified strategic direction of the combatant forces, for their operation under unified command, and for their integration into an efficient team of land, naval, and air forces but not to establish a single Chief of Staff over the armed forces nor an over-all armed forces general staff."

To provide guidance in accordance with the policy declared by Congress, the Secretary of Defense, with the approval of the President, hereby promulgates the following statement of the functions of the Department of Defense and its major components.

II. ORGANIZATIONAL RELATIONSHIPS IN THE DEPARTMENT OF DEFENSE

1. All functions in the Department of Defense and its component agencies are performed under the direction, authority, and control of the Secretary of Defense.

2. The Department of Defense includes the Office of the Secretary of Defense and the Joint Chiefs of Staff, the military departments and the military services within those departments, the unified and specified commands, and such other agencies as the Secretary of Defense establishes to meet specific requirements.

a. In providing immediate staff assistance and advice to the Secretary of Defense, the Office of the Secretary of Defense, and the Joint Chiefs of Staff, though separately identified and organized, function in full coordination and cooperation in accordance with Reference (b).

(1) The Office of the Secretary of Defense includes the offices of the Director of Defense Research and Engineering, the Assistant Secretaries of Defense, and the General Counsel and such other staff offices as the Secretary of Defense establishes to assist him in carrying out his duties and responsibilities. The functions of the heads of these offices shall be as assigned by the Secretary of

Defense in accordance with existing laws.

(2) The Joint Chiefs of Staff, as a group, are directly responsible to the Secretary of Defense for the functions assigned to them. Each member of the Joint Chiefs of Staff, other than the Chairman, is responsible for keeping the Secretary of his military department fully informed on matters considered or acted upon by the Joint Chiefs of Staff.

b. Each military department (the Department of the Navy to include naval aviation and the United States Marine Corps) shall be separately organized under its own secretary and shall function under the direction, authority, and control of the Secretary of Defense. The secretary of a military department shall be responsible to the Secretary of Defense for the operation of such departments as well as its efficiency. Orders to the military departments will be issued through the secretaries of these departments, or their designees, by the Secretary of Defense or under authority specifically delegated in writing by the Secretary of Defense or provided by law.

c. Commanders of unified and specified commands are responsible to the President and the Secretary of Defense for the accomplishment of the military missions assigned to them. The chain of command runs from the President to the Secretary of Defense and through the Joint Chiefs of Staff to the commanders of unified and specified commands. Orders to such commanders will be issued by the President or the Secretary of Defense, or by the Joint Chiefs of Staff by authority and direction of the Secretary of Defense. These commanders shall have full operational command over the forces assigned to them and shall perform such functions as are prescribed by the Unified Command Plan and other directives issued by competent authority.

3. The functions assigned hereinafter may be transferred, reassigned, abolished, or consolidated by the Secretary of Defense in accordance with the procedures established and the authorities provided in the National Security Act of 1947, as amended.

III. FUNCTIONS OF THE DEPARTMENT OF DEFENSE

As prescribed by higher authority, the Department of Defense shall maintain and employ armed forces:

1. To support and defend the Constitution of the United States against all enemies, foreign and domestic.

2. To ensure, by timely and effective military action, the security of the United States, its possessions, and areas vital to its interest.

3. To uphold and advance the national policies and interests of the United States.

4. To safeguard the internal security of the United States.

IV. FUNCTIONS OF THE JOINT CHIEFS OF STAFF

The Joint Chiefs of Staff, consisting of the Chairman; the Chief of Staff, US Army; the Chief of Naval Operations; and the Chief of Staff, US Air Force, and supported by the Organization of the Joint Chiefs of Staff, constitute the immediate military staff of the Secretary of Defense. The Joint Chiefs of Staff are the principal military advisers to the President, the National Security Council, and the Secretary of Defense. The Commandant of the US Marine Corps has coequal status with the members of the Joint Chiefs of Staff on matters which directly concern the Marine Corps. In performance of their functions of advising and assisting the Secretary of Defense, and subject to the authority and direction of the President and the Secretary of Defense, it shall be the duty of the Joint Chiefs of Staff:

1. To serve as advisers and as military staff in the chain of operational command with respect to unified and specified commands, to provide a channel of communications from the President and Secretary of Defense to unified and specified commands, and to coordinate all communications in matters of joint interest addressed to the commanders of the unified or specified commands by other authority.

2. To prepare strategic plans and provide for the strategic direction of the armed forces, including the direction of operations conducted by commanders of unified and specified commands and the discharge of any other function of command for such commands directed by the Secretary of Defense.

3. To prepare integrated logistic plans, which may include assignments to the armed forces of logistic responsibilities in accordance with such plans.

4. To prepare integrated plans for military mobilization.

5. To provide adequate, timely, and reliable joint intelligence for use within the Department of Defense.

6. To review major personnel, material, and logistic requirements of the armed forces in relation to strategic and logistic plans.

7. To review the plans and programs of commanders of unified and specified commands to determine their adequacy, feasibility, and suitability for the performance of assigned missions.

8. To provide military guidance for use by the military departments and the armed forces as needed in the preparation of their respective detailed plans.

9. To participate, as directed, in the preparation of combined plans for military action in conjunction with the armed forces of other nations.

10. To recommend to the Secretary of Defense the establishment and force structure of unified and specified commands in strategic areas.

11. To determine the headquarters support, such as facilities, personnel, and communications, required by commanders of unified and specified commands and to recommend the assignment to the military departments of the responsibilities for providing such support.

12. To establish doctrines for (a) unified operations and training and (b) coordination of the military education of members of the armed forces.

13. To recommend to the Secretary of Defense the assignment of primary responsibility for any function of the armed forces requiring such determination and the transfer, reassignment, abolition, or consolidation of such functions.

14. To prepare and submit to the Secretary of Defense, for information and consideration in connection with the preparation of budgets, statements of military requirements based upon United States strategic considerations, current national security policy, and strategic war plans. These statements of requirements shall include tasks, priority of tasks, force requirements, and general strategic guidance for the development of military installations and bases and for equipping and maintaining military forces.

15. To advise and assist the Secretary of Defense in research and engineering matters by preparing: (a) statements of broad strategic guidance to be used in the preparation of an integrated Department of Defense program; (b) statements of over-all military requirements; (c) statements of the relative military importance of development activities to meet the needs of the unified and specified commanders; and (d) recommendations for the assignment of specific new weapons to the armed forces.

(Continued on following page)

16. To prepare and submit to the Secretary of Defense for information and consideration general strategic guidance for the development of industrial mobilization programs.

17. To prepare and submit to the Secretary of Defense military guidance for use in the development of military aid programs and other actions relating to foreign military forces, including recommendations for allied military force, materiel, and facilities requirements related to United States strategic objectives, current national security policy, strategic war plans, and the implementation of approved programs; and to make recommendations to the Secretary of Defense, as necessary, for keeping the Military Assistance Program in consonance with agreed strategic concepts.

18. To provide United States representation on the Military Staff Committee of the United Nations, in accordance with the provisions of the Charter of the United Nations, and representation on other properly authorized military staffs, boards, councils, and missions.

19. To perform such other duties as the President or the Secretary of Defense may prescribe.

V. FUNCTIONS OF THE MILITARY DEPARTMENTS AND THE MILITARY SERVICES

The chain of command for purposes other than the operational direction of unified and specified commands runs from the President to the Secretary of Defense to the secretaries of the military departments.

The military departments, under their respective secretaries and in accordance with Sections II and IV, shall:

1. Prepare forces and establish reserves of equipment and supplies for the effective prosecution of war, and plan for the expansion of peacetime components to meet the needs of war.

2. Maintain in readiness mobile reserve forces, properly organized, trained, and equipped for employment in emergency.

3. Provide adequate, timely, and reliable departmental intelligence for use within the Department of Defense.

4. Organize, train, and equip forces for assignment to unified or specified commands.

5. Prepare and submit to the Secretary of Defense budgets for their respective departments; justify before the Congress budget requests as approved by the Secretary of Defense; and administer the funds made available for maintaining, equipping, and training the forces of their respective departments, including those assigned to unified and specified commands. The budget submissions to the Secretary of Defense by the military departments shall be prepared on the basis, among other things, of the advice of commanders of forces assigned to unified and specified commands; such advice, in the case of component commanders of unified commands, will be in agreement with the plans and programs of the respective unified commanders.

6. Conduct research; develop tactics, techniques, and organization; and develop and procure weapons, equipment, and supplies essential to the fulfillment of the functions hereinafter assigned.

7. Develop, garrison, supply, equip, and maintain bases and other installations, including lines of communication, and provide administrative and logistical support for all forces and bases.

8. Provide, as directed, such forces, military missions, and detachments for service in foreign countries as may be required to support the national interests of the United States.

9. Assist in training and equipping the military forces of foreign nations.

10. Assist each other in the accomplishment of their respective functions, including the provision of personnel, intelligence, training, facilities, equipment, supplies, and services.

The forces developed and trained to perform the primary functions set forth hereinafter shall be employed to support and supplement the other services in carrying out their primary functions, where and whenever such participation will result in increased effectiveness and will contribute to the accomplishment of the over-all military objectives. As for collateral functions, while the assignment of such functions may establish further justification for stated force requirements, such assignment shall not be used as the basis for establishing additional force requirements.

A. Functions of the Department of the Army

The Department of the Army is responsible for the preparation of land forces necessary for the effective prosecution of war except as otherwise assigned and, in accordance with integrated mobilization plans, for the expansion of the peacetime components of the Army to meet the needs of war.

The Army, within the Department of the Army, includes land combat and service forces and such aviation and water transport as may be organic therein.

1. Primary Functions of the Army

a. To organize, train, and equip Army forces for the conduct of prompt and sustained combat operations on land—specifically, forces to defeat enemy land forces and to seize, occupy, and defend land area.

b. To organize, train, and equip Army air defense units, including the provision of Army forces as required for the defense of the United States against air attack, in accordance with doctrines established by the Joint Chiefs of Staff.

c. To organize and equip, in coordination with the other services, and to provide Army forces for joint amphibious and airborne operations, and to provide for the training of such forces, in accordance with doctrines established by the Joint Chiefs of Staff.

(1) To develop, in coordination with the other services, doctrines, tactics, techniques, and equipment of interest to the Army for amphibious operations and not provided for in Section V, paragraph B 1 b (3) and paragraph B 1 d.

(2) To develop, in coordination with the other services, the doctrines, procedures, and equipment employed by Army and Marine forces in airborne operations. The Army shall have primary interest in the development of those airborne doctrines, procedures, and equipment which are of common interest to the Army and the Marine Corps.

d. To provide an organization capable of furnishing adequate, timely, and reliable intelligence for the Army.

e. To provide forces for the occupations of territories abroad, to include initial establishment of military government pending transfer of this responsibility to other authority.

f. To formulate doctrines and procedures for the organizing, equipping, training, and employment of forces operating on land, except that the formulation of doctrines

(Continued on page 135)

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and procedures for the organization, equipping, training, and employment of Marine Corps units for amphibious operations shall be a function of the Department of the Navy, coordinating as required by Section V, paragraph B 1 b (3).

g. To conduct the following activities:

(1) The administration and operation of the Panama Canal.

(2) The authorized civil works program, including projects for improvement of navigation, flood control, beach erosion control, and other water resource developments in the United States, its territories, and its possessions.

(3) Certain other civil activities prescribed by law.

2. **Collateral Functions of the Army**—To train forces:

a. To interdict enemy sea and airpower and communications through operations on or from land.

B. Functions of the Department of the Navy

The Department of the Navy is responsible for the preparation of Navy and Marine Corps forces necessary for the effective prosecution of war except as otherwise assigned and, in accordance with integrated mobilization plans, for the expansion of the peacetime components of the Navy and Marine Corps to meet the needs of war.

Within the Department of the Navy, the Navy includes naval combat and service forces and such aviation as may be organic therein, and the Marine Corps includes not less than three combat divisions and three air wings and such other land combat, aviation, and other services as may be organic therein.

1. **Primary Functions of the Navy and the Marine Corps**

a. To organize, train, and equip Navy and Marine Corps forces for the conduct of prompt and sustained combat operations at sea, including operations of sea-based aircraft and land-based naval air components—specifically, forces to seek out and destroy enemy naval forces and to suppress enemy sea commerce, to gain and maintain general naval supremacy, to control vital sea areas and to protect vital sea lines of communication, to establish and maintain local superiority (including air) in an area of naval operations, to seize and defend advanced naval bases, and to conduct such land and air operations as may be essential to the prosecution of a naval campaign.

b. To maintain the Marine Corps, having the following specific functions:

(1) To provide fleet Marine forces of combined arms, together with supporting air components, for service with the fleet in the seizure or defense of advanced naval bases and for the conduct of such land operations as may be essential to the prosecution of a naval campaign. These functions do not contemplate the creation of a second land Army.

(2) To provide detachments and organizations for service on armed vessels of the Navy, and security detachments for the protection of naval property at naval stations and bases.

(3) To develop, in coordination with the other services, the doctrines, tactics, techniques, and equipment employed by landing forces in amphibious operations. The Marine Corps shall have primary interest in the development of those landing-force doctrines, tactics, techniques, and equipment which are of common interest to the Army and the Marine Corps.

(4) To train and equip, as required, Marine forces for airborne operations, in coordination with the other services and in accordance with doctrines established by the Joint Chiefs of Staff.

(5) To develop, in coordination with the other services, doctrines, procedures, and equipment of interest to the Marine Corps for airborne operations and not provided for in Section V, paragraph A 1 c (2).

c. To organize and equip, in coordination with the other services, and to provide naval forces, including naval close air-support forces, for the conduct of joint amphibious operations, and to be responsible for the amphibious training of all forces assigned to joint amphibious operations in accordance with doctrines established by the Joint Chiefs of Staff.

d. To develop, in coordination with the other services, the doctrines, procedures, and equipment of naval forces for amphibious operations, and the doctrines and procedures for joint amphibious operations.

e. To furnish adequate, timely, and reliable intelligence for the Navy and Marine Corps.

f. To organize, train, and equip naval forces for naval reconnaissance, antisubmarine warfare, protection of shipping, and mine laying, including the air aspects thereof, and controlled mine-field operations.

g. To provide air support essential for naval operations.

h. To provide sea-based air defense and the sea-based means for coordinating control for defense against air attack, coordinating with the other services in matters of joint concern.

i. To provide naval (including naval air) forces as required for the defense of the United States against air attack, in accordance with doctrines established by the Joint Chiefs of Staff.

j. To furnish aerial photography as necessary for Navy and Marine Corps operations.

2. **Collateral Functions of the Navy and the Marine Corps**—To train forces:

a. To interdict enemy land and airpower and communications through operations at sea.

b. To conduct close air and naval support for land operations.

c. To furnish aerial photography for cartographic purposes.

d. To be prepared to participate in the over-all air effort as directed.

e. To establish military government, as directed, pending transfer of this responsibility to other authority.

C. Functions of the Department of the Air Force

The Department of the Air Force is responsible for the preparation of the air forces necessary for the effective prosecution of war except as otherwise assigned and, in accordance with integrated mobilization plans, for the expansion of the peacetime components of the Air Force to meet the needs of war.

The Air Force, within the Department of the Air Force, includes aviation forces, both combat and service, not otherwise assigned.

1. **Primary Functions of the Air Force**

a. To organize, train, and equip Air Force forces for the conduct of prompt and sustained combat operations in the air—specifically, forces to defend the United States against air attack in accordance with doctrines established by the Joint Chiefs of Staff, to gain and maintain general air supremacy, to defeat enemy air forces, to control vital

(Continued on following page)

air areas, and to establish local air superiority except as otherwise assigned herein.

b. To develop doctrines and procedures, in coordination with the other services, for the unified defense of the United States against air attack.

c. To organize, train, and equip Air Force forces for strategic air warfare.

d. To organize and equip Air Force forces for joint amphibious and airborne operations, in coordination with the other services, and to provide for their training in accordance with doctrines established by the Joint Chiefs of Staff.

e. To furnish close combat and logistical air support to the Army, to include airlift, support, and resupply of airborne operations, aerial photography, tactical reconnaissance, and interdiction of enemy land power and communications.

f. To provide air transport for the armed forces, except as otherwise assigned.

g. To develop, in coordination with the other services, doctrines, procedures, and equipment for air defense from land areas, including the continental United States.

h. To formulate doctrines and procedures for the organizing, equipping, training, and employment of Air Force forces.

i. To provide an organization capable of furnishing adequate, timely, and reliable intelligence for the Air Force.

j. To furnish aerial photography for cartographic purposes.

k. To develop, in coordination with the other services, tactics, techniques, and equipment of interest to the Air Force for amphibious operations and not provided for in Section V, paragraph B 1 b (3) and paragraph B 1 d.

l. To develop, in coordination with the other services, doctrines, procedures, and equipment employed by Air Force forces in airborne operations.

2. **Collateral Functions of the Air Force**—To train forces:

a. To interdict enemy seapower through air operations.

b. To conduct antisubmarine warfare and to protect shipping.

c. To conduct aerial mine-laying operations.

VI. CANCELLATION

Reference (a) is canceled.

VII. EFFECTIVE DATE

This Directive is effective immediately.

NEIL H. MCELROY
Secretary of Defense

AIR FORCE
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Organization of the JOINT CHIEFS OF STAFF

SUBJECT Organization of the Joint Chiefs of Staff and Relationships with the Office of the Secretary of Defense

REFERENCES: (a) *DoD Directive 5158.1, "Method of Operation of the Joint Chiefs of Staff and Their Relationships with Other Staff Agencies of the Office of the Secretary of Defense," July 26, 1954 (canceled herein)*

(b) *DoD Directive 5100.1, "Functions of the Department of Defense and its Major Components"*

I. PURPOSE

The Department of Defense Reorganization Act of 1958 and the President's Message to the Congress of April 3, 1958, set forth general policies, procedures, and organizational relationships required for the effective direction of the entire defense establishment.

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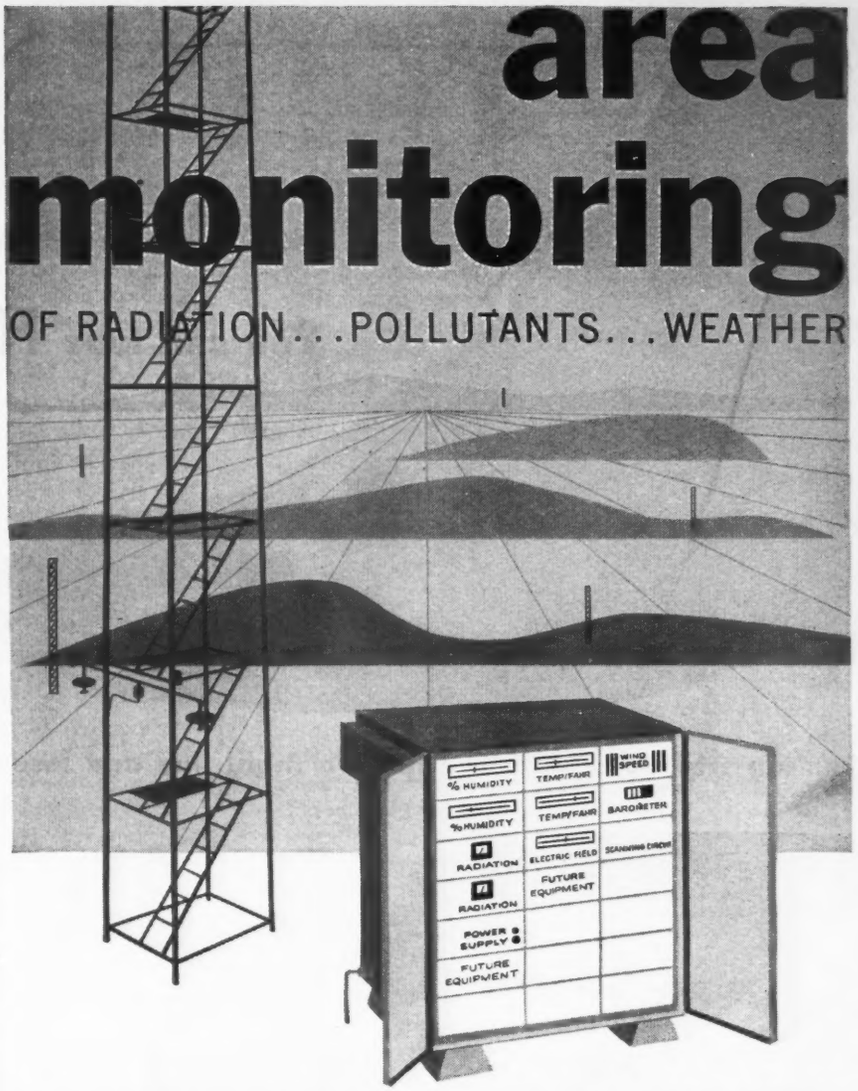

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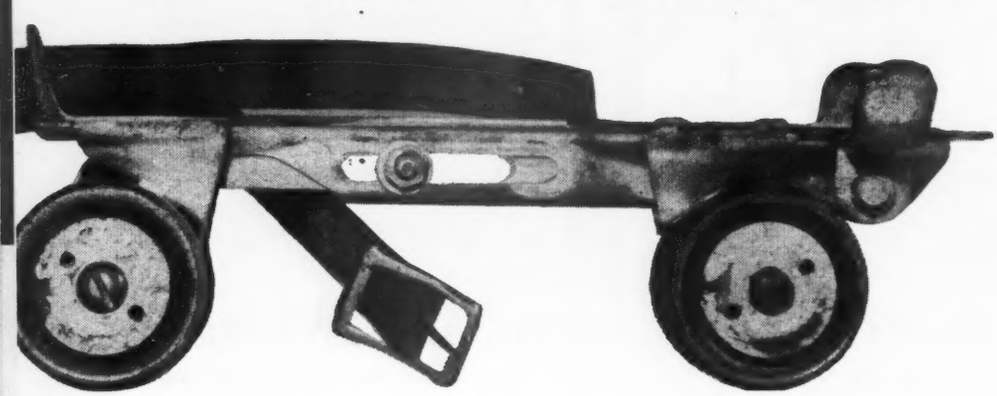

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The President's Message singles out the accomplishment of the following objective as one of the paramount duties of the Secretary of Defense, acting with the advice and assistance of the Joint Chiefs of Staff and under the supervision of the Commander in Chief:

"Strategic and tactical planning must be completely unified, combat forces organized into unified commands, each equipped with the most efficient weapon systems that science can develop, singly led and prepared to fight as one, regardless of service."

This Directive implements the Department of Defense Reorganization Act of 1958 and the President's Message of April 3, 1958, with respect to the organization of the Joint Chiefs of Staff and relationships with the major offices in the Office of the Secretary of Defense, i.e., those of the Director of Defense Research and Engineering, the Assistant Secretaries of Defense, the General Counsel, the Assistants to the Secretary of Defense, and the heads of other offices established by the Secretary of Defense.

The functions of the Department of Defense and its major components have been set forth in Reference (b).

II. RESPONSIBILITIES AND PROCEDURES

A. The duties of the Chiefs of the military services as members of the Joint Chiefs of Staff shall take precedence over all of their other duties. To ensure that the Chiefs of the military services have adequate time to devote to their duties as members of the Joint Chiefs of Staff, they shall delegate appropriate duties to their Vice Chiefs.

B. The Joint Chiefs of Staff shall, in discharging their responsibilities, avail themselves of the most competent and considered thinking that can be obtained representing every pertinent point of view, including scientific, industrial, and economic as well as military.

C. To ensure that planning and operations will be of the highest order:

1. All elements of the organization of the Joint Chiefs of Staff shall cooperate fully and effectively with appropriate offices of the Office of the Secretary of Defense. In all stages of important staff studies, the organization of the Joint Chiefs of Staff shall avail itself of the views and special skills in the Office of the Secretary of Defense. As a normal procedure, specialized data necessary for the preparation of such studies will be obtained from or through the appropriate offices of the Office of the Secretary of Defense.

2. The directors of the various directorates of the Joint Staff shall maintain active liaison with appropriate offices of the Office of the Secretary of Defense. This shall include, but not be limited to, the exchange of information, interchange of technical advice, and guidance for mutual benefit. The heads of offices in the Office of the Secretary of Defense shall maintain similar liaison and make representatives available to meet formally or informally with appropriate members of the organization of the Joint Chiefs of Staff.

D. Directives and orders to the Joint Chiefs of Staff will be issued by the Secretary or the Deputy Secretary of Defense. Requests to the Joint Chiefs of Staff or to the Chairman of the Joint Chiefs of Staff, involving action by the Joint Chiefs of Staff, may be issued by responsible officials of the Office of the Secretary of Defense in accordance with authority specifically delegated by the Secretary of Defense.

E. Development of strategic and logistic plans will be based on the broadest concepts of over-all national interests, and personnel of the organization of the Joint Chiefs of Staff shall be selected with due regard for their competency and ability to support such interests.

F. The Chairman of the Joint Chiefs of Staff shall have the authority and responsibility for:

1. Serving as a member of and presiding over the Joint Chiefs of Staff.

2. Providing the agenda for meetings of the Joint Chiefs of Staff and assisting them to prosecute their business as promptly as it practicable.

3. Furnishing the Secretary of Defense with periodic progress reports on important items of current interest being considered by the Joint Chiefs of Staff.

4. Keeping the Secretary of Defense informed on issues upon which agreement among the Joint Chiefs of Staff has not been reached, and forwarding to the Secretary of Defense the recommendations, advice, and views of the Joint Chiefs of Staff, including any divergencies.

5. Arranging for the provision of military advice to all offices of the Office of the Secretary of Defense.

6. Making arrangements to relieve the Joint Chiefs of Staff of matters of lesser importance.

7. Organizing the Joint Staff and the subordinate structure of the organization of the Joint Chiefs of Staff to ensure that they are designed to accomplish efficiently the tasks to be assigned.

8. Managing the Joint Staff and its Director on behalf of the Joint Chiefs of Staff. The term manage means to conduct, to guide, and to administer the work of the elements affected, and to ensure that the work is performed in a manner that will permit the Secretary of Defense and the Joint Chiefs of Staff to discharge their total responsibilities. The Joint Staff shall perform such duties as the Joint Chiefs of Staff or the Chairman of the Joint Chiefs of Staff prescribes.

9. Keeping the Joint Chiefs of Staff informed, as appropriate, concerning any matter that is referred by the Chairman to the Secretary of Defense with a recommendation that it be assigned to a military department for consideration or action.

10. Appointing consultants to the Joint Chiefs of Staff from outside the Department of Defense, subject to the approval of the Secretary of Defense and with the advice of the Joint Chiefs of Staff.

G. The selection of the Director, Joint Staff, and of the members of the organization of the Joint Chiefs of Staff shall be as follows:

1. The Director, Joint Staff, shall be selected and his tenure fixed by the Chairman of the Joint Chiefs of Staff, in consultation with the Joint Chiefs of Staff and with the approval of the Secretary of Defense. The normal tenure of the Director will be two years; any extension of this tenure may not exceed one year except in time of war.

2. The members of the organization of the Joint Chiefs of Staff shall be selected by the Joint Chiefs of Staff with the approval of the Chairman of the Joint Chiefs of Staff.

H. The duties and manner of operation of the Operations Deputies will be prescribed by the Joint Chiefs.

I. In order to carry out the objectives of paragraph II, C, above, the Director, Joint Staff, and appropriate heads of offices in the Office of the Secretary of Defense have the specific duty and authority of ensuring that there is full cooperation between their respective agencies.

III. CANCELLATION

Reference (a) is canceled.

IV. EFFECTIVE DATE

This Directive shall be effective immediately.

NEIL H. MCELROY
Secretary of Defense

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